OCR
RECOGNISING ACHIEVEMENT

Thursday 31 May 2012 – Morning

AS GCE MATHEMATICS (MEI)

4771 Decision Mathematics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4771
- 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 graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- 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 The table defines a network in which the numbers represent lengths.

	A	B	C	D	E	F	G
A	–	3	8	–	5	–	–
B	3	–	4	–	–	–	6
C	8	4	–	1	1	–	2
D	–	–	1	–	–	–	5
E	5	–	1	–	–	4	–
F	–	–	–	–	4	–	1
G	–	6	2	5	–	1	–

(i) Draw the network. **[2]**

(ii) Use Dijkstra's algorithm to find the shortest route from A to G. Give the route and its length. **[6]**

2 This question concerns the following algorithm which operates on a given function, f. The algorithm finds a point between A and B at which the function has a minimum, with a maximum error of 0.05.

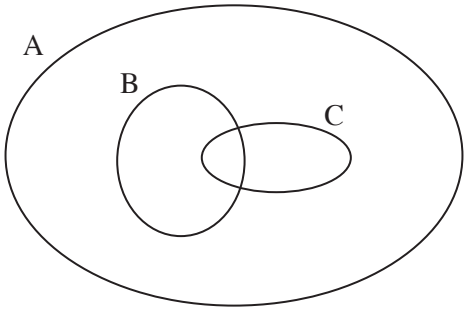
Step 1	Input A
Step 2	Input B, where $B > A$
Step 3	Let $R = A + \left(\frac{\sqrt{5}-1}{2}\right) \times (B - A)$
Step 4	Let $L = A + B - R$
Step 5	Find f(L) and f(R)
Step 6	If $f(L) \leqslant f(R)$ then let B = R and go to Step 8
Step 7	If $f(L) > f(R)$ then let A = L and go to Step 8
Step 8	If $B - A < 0.1$ then go to step 10
Step 9	Go to step 3
Step 10	Print $\frac{(A+B)}{2}$ and stop

(i) Working correct to three decimal places, perform two iterations of the algorithm for $f(x) = 2x^2 - 15x + 30$, when A = 3 and B = 4. Start at Step 1 and stop when you reach Step 8 for the second time. **[6]**

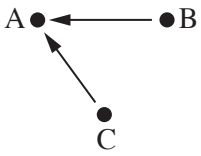
(ii) The $\left(\frac{\sqrt{5}-1}{2}\right)$ factor in Step 3 ensures that either the new 'L' is equal to the old 'R', or vice versa. Why is this important? **[1]**

(iii) This algorithm is used when the function is not known explicitly, but where its value can be found for any given input. Give a practical example of where it might be used. **[1]**

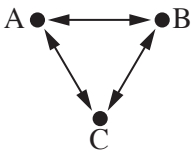
3 The diagram shows three sets, A, B and C. Each region of the diagram contains at least one element. The diagram shows that B is a subset of A, C is a subset of A, and that B shares at least one element with C.



The two graphs below give information about the three sets A, B and C. The first graph shows the relation 'is a subset of' and the second graph shows the relation 'shares at least one element with'.

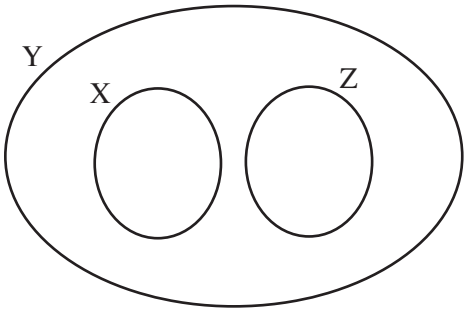


'is a subset of'

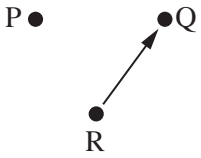


'shares at least one element with'

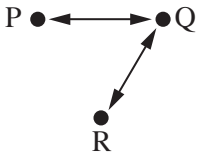
(i) Draw two graphs to represent the sets X, Y and Z shown in the following diagram. **[4]**



(ii) Draw a diagram to represent the sets P, Q and R for which both of the following graphs apply. **[4]**



'is a subset of'



'shares at least one element with'

Section B (48 marks)

4 In a factory, two types of motor are made. Each motor of type X takes 10 man hours to make and each motor of type Y takes 12 man hours to make.

In each week there are 200 man hours available.

To satisfy customer demand, at least 5 of each type of motor must be made each week.

Once a motor has been started it must be completed; no unfinished motors may be left in the factory at the end of each week.

When completed, the motors are put into a container for shipping. The volume of the container is $7\,m^3$. A type X motor occupies a volume of $0.5\,m^3$ and a type Y motor occupies a volume of $0.3\,m^3$.

(i) Define appropriate variables and from the above information derive four inequalities which must be satisfied by those variables. **[5]**

(ii) Represent your inequalities on a graph and shade the infeasible region. **[4]**

The profit on each type X is £100 and on each type Y is £70.

(iii) The weekly profit is to be maximised. Write down the objective function and find the maximum profit. **[3]**

(iv) Because of absenteeism, the manager decides to organise the work in the factory on the assumption that there will be only 180 man hours available each week. Find the number of motors of each type that should now be made in order to maximise the profit. **[4]**

5 Each morning I reach into my box of tea bags and, without looking, randomly choose a bag. The bags are manufactured in pairs, which can be separated along a perforated line. So when I choose a bag it might be attached to another, in which case I have to separate them and return the other bag to the box. Alternatively, it might be a single bag, having been separated on an earlier day.

I only use one tea bag per day, and the box always gets thoroughly shaken during the day as things are moved around in the kitchen.

You are to simulate this process, starting with 5 double bags and 0 single bags in the box. You are to use single-digit random numbers in your simulation.

(i) On day 2 there will be 4 double bags and 1 single bag in the box, 9 bags in total. Give a rule for simulating whether I choose a single bag or a double bag, assuming that I am equally likely to choose any of the 9 bags. Use single-digit random numbers in your simulation rule. **[2]**

(ii) On day 3 there will either be 4 double bags or 3 double bags and 2 single bags in the box. Give a rule for simulating what sort of bag I choose in the second of these cases. Use single-digit random numbers in your simulation rule. **[2]**

(iii) Using the random digits in your answer book, simulate what happens on days 2, 3 and 4, briefly explaining your simulations. Give an estimate of the probability that I choose a single bag on day 5. **[8]**

(iv) Using the random digits in your answer book, carry out 4 more simulations and record the results. **[2]**

(v) Using your 5 simulations, estimate the probability that I choose a single bag on day 5. **[2]**

[Question 6 is printed overleaf.]

6 The table shows the tasks involved in making a batch of buns, the time in minutes required for each task, and their precedences.

Task		Time (minutes)	Immediate predecessors
A	measure out flour	0.5	–
B	mix flour and water	1	A
C	shell eggs	0.5	–
D	mix in eggs and fat	2	B, C
E	get currants ready	0.5	–
F	get raisins ready	0.5	–
G	fold fruit into mix	0.5	D, E, F
H	bake	10	G

(i) Draw an activity on arc network for these activities. **[5]**

(ii) Mark on your diagram the early time and the late time for each event. Give the minimum completion time and the critical activities. **[6]**

Preparing the batch for baking consists of tasks A to G; each of these tasks can only be done by one person. *Baking*, task H, requires no people.

(iii) How many people are required to prepare the batch for baking in the minimum time? **[1]**

(iv) What is the minimum time required to prepare the batch for baking if only one person is available? **[1]**

Jim is preparing and baking three batches of buns. He has one oven available for baking. For the rest of the question you should consider 'preparing the batch for baking' as one activity.

(v) Assuming that the oven can bake only one batch at a time, draw an activity on arc diagram for this situation and give the minimum time in which the three batches of buns can be prepared and baked. **[2]**

(vi) Assuming that the oven is big enough to bake all three batches of buns at the same time, give the minimum time in which the three batches of buns can be prepared and baked. **[1]**

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RECOGNISING ACHIEVEMENT

Thursday 31 May 2012 – Morning

AS GCE MATHEMATICS (MEI)

4771 Decision Mathematics 1

PRINTED ANSWER BOOK

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OCR supplied materials:
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Other materials required:
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Duration: 1 hour 30 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

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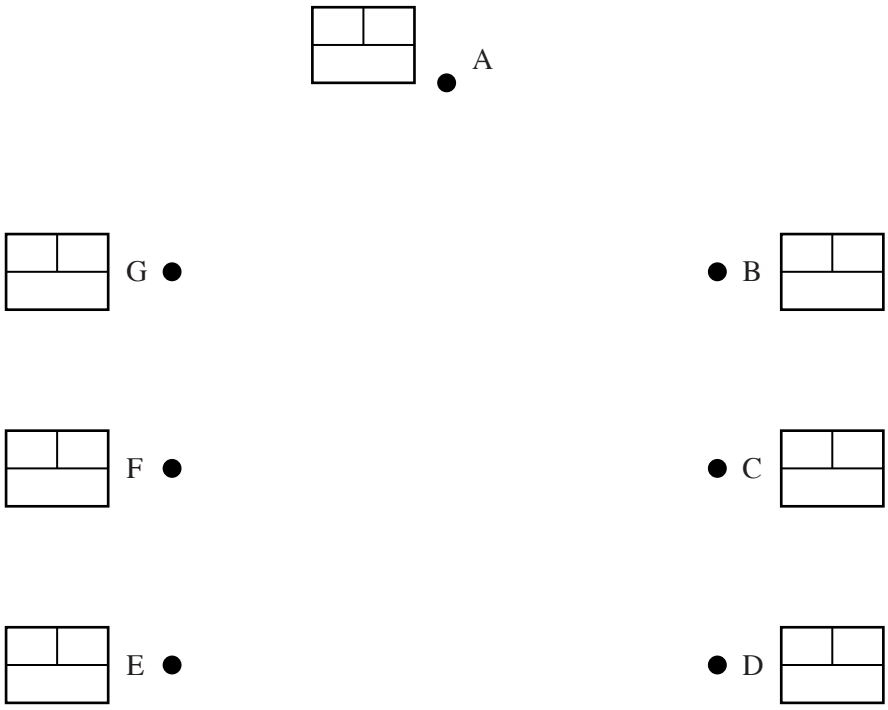
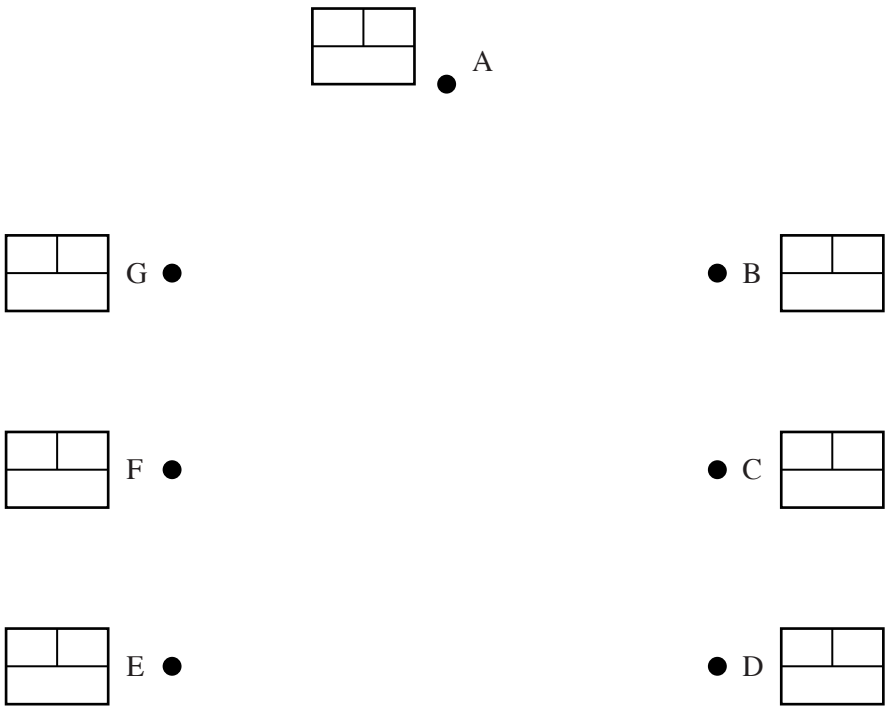
Section A (24 marks)

1 (i) & (ii)



Spare copy of diagram for 1(i)

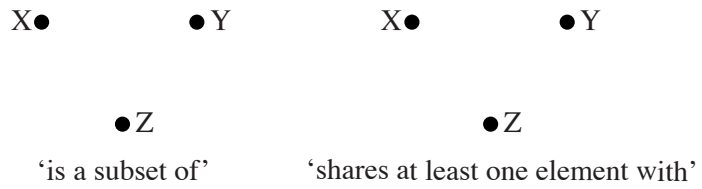


2 (i)

A	L	R	B	f(L)	f(R)

2 (ii)

2 (iii)

3 (i)	
3 (ii)	

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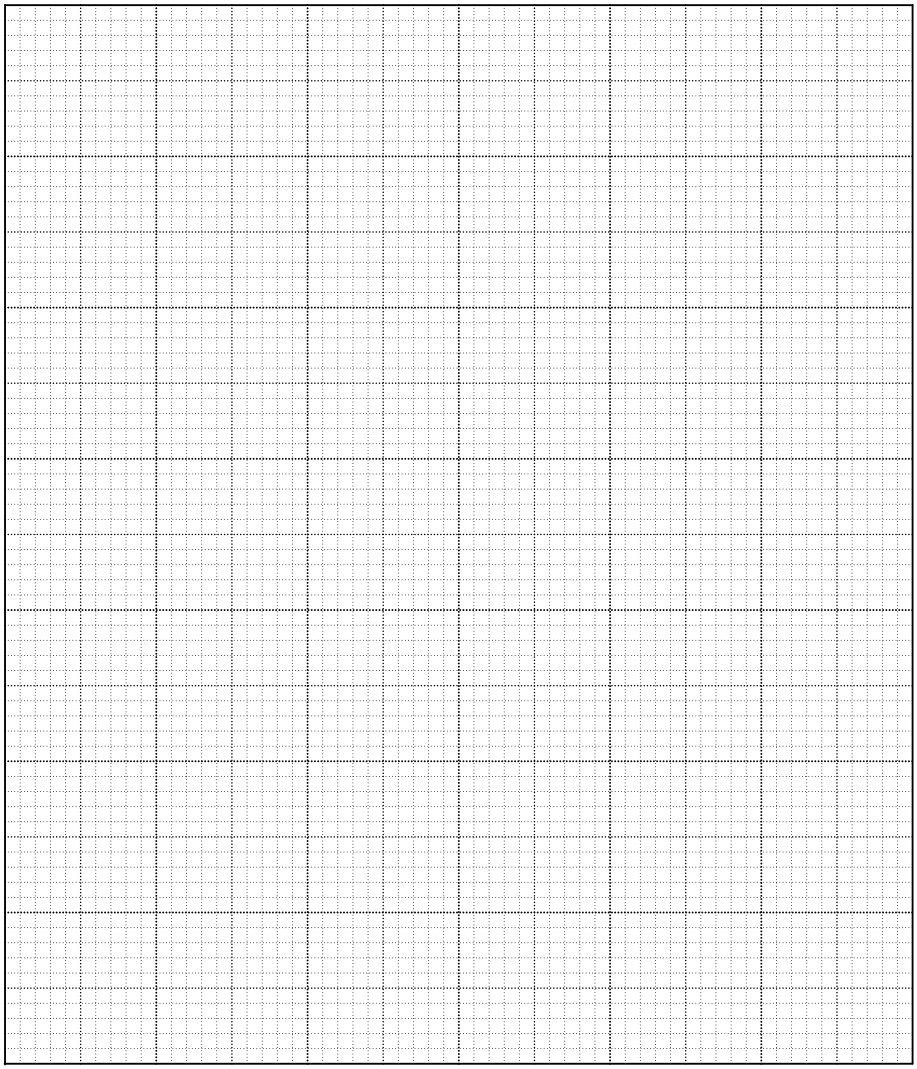
Section B (48 marks)

4 (i)

4 (ii)



A spare copy of this graph paper can be found on page 12.

4 (iii)	
4 (iv)	

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5 (i)

5 (ii)

5 (iii) Random digits: 5, 9, 4, 0, 8, 1, 9, 3, 0, 5

5 (iv) Random digits for run 2: 0, 1, 3, 7, 5, 9, 9, 8, 7, 3

Random digits for run 3: 9, 8, 4, 4, 2, 7, 7, 4, 1, 9

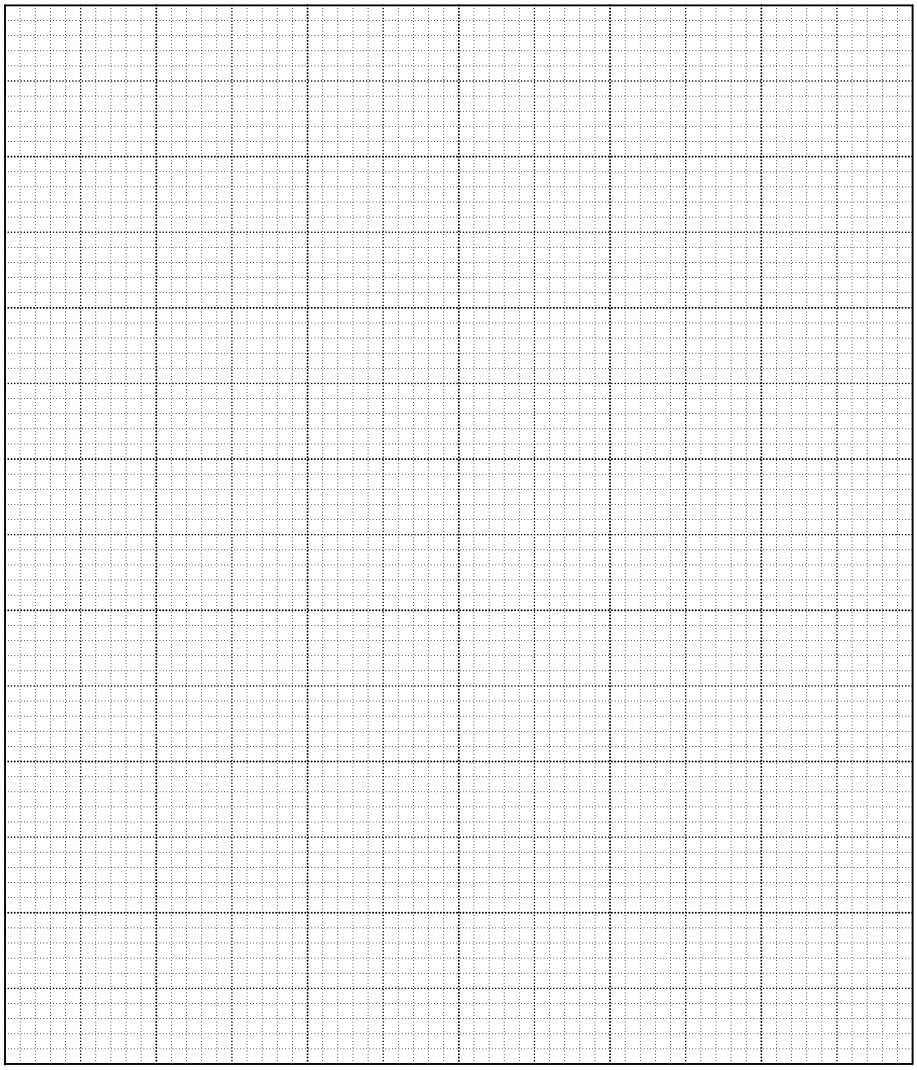
(answer space continued on next page)

5 (iv)	**(continued)**
	Random digits for run 4: 9, 0, 5, 1, 6, 9, 6, 0, 6, 5
	Random digits for run 5: 0, 9, 1, 8, 8, 9, 0, 6, 5, 5
5 (v)	

6 (i) & (ii)	

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

Spare copy of graph paper for question 4(ii)



OCR
RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4771:** Decision Mathematics 1

Mark Scheme for June 2012

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, OCR Nationals, 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.

Any enquiries about publications should be addressed to:

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Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

Annotations

Annotation	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

a. Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

b. An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact your Team Leader.

c. The following types of marks are available.

M
A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

E
A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d. When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e. The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f. Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise. Candidates are expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figures often being the norm. Small variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not normally be penalised, while answers which are grossly over- or under-specified should normally result in the loss of a mark. The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.

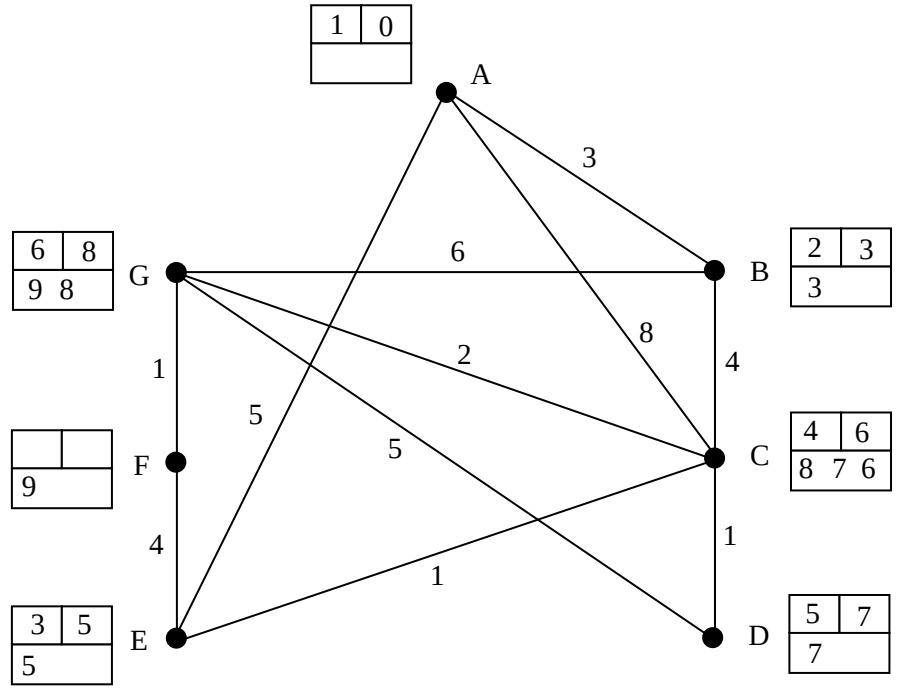
g. Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.
If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

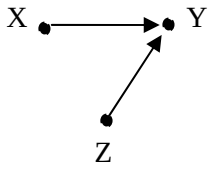
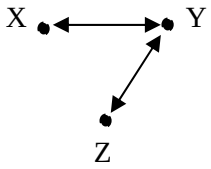
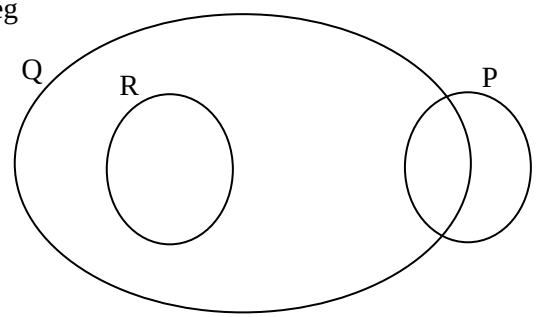
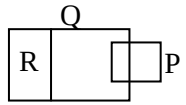
NB Follow these maths-specific instructions rather than those in the assessor handbook.

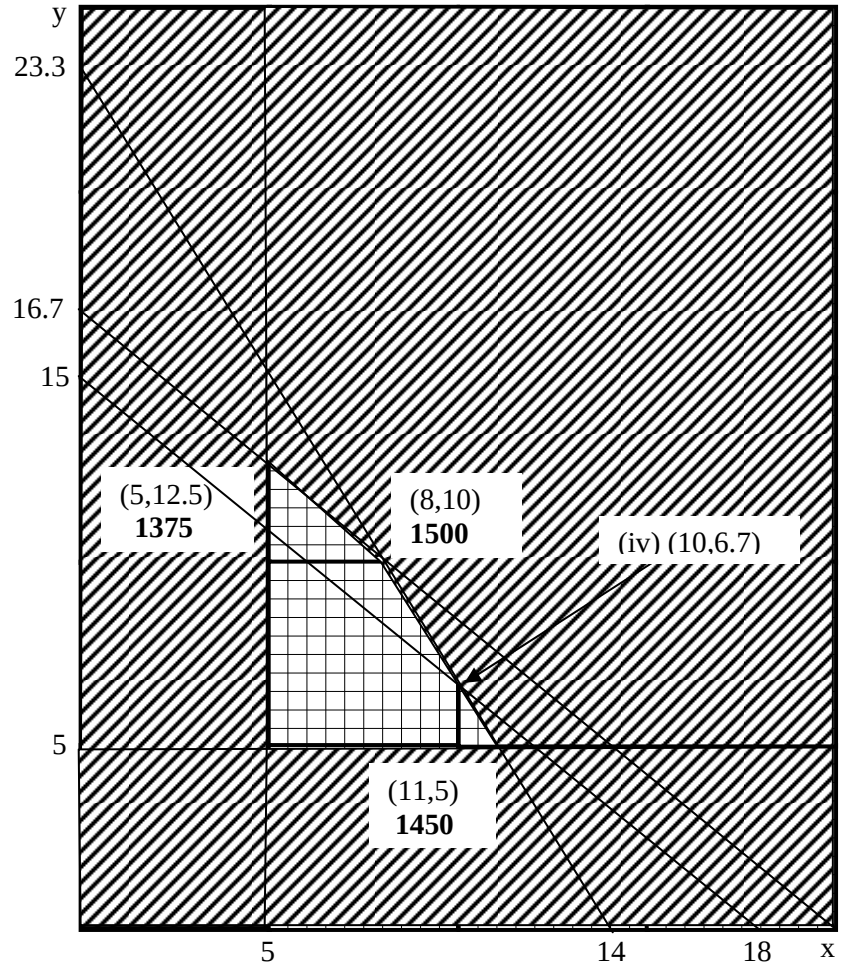
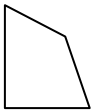
h. For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some 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.

Question	Answer	Marks	Guidance
1 (i) & (ii)	 Route: AECG Distance: 8	B1 B1 B1 B1 B1 B1 B1 B1 **[8]**	connectivity lengths Dijkstra working values other than at C order of labelling labels

Question			Answer	Marks	Guidance	
2	(i)		A L R B f(L) f(R) 3 3.382 3.618 4 2.146 1.910 3.382 3.618 3.764 4 1.910 1.875 3.618	B1 B1 B1 B1 B1 B1 **[6]**	R and L f(R) and f(L) A L and R f(L) and F(R) A	-1 once only for incorrect accuracy, but condone 1.91. Surds OK, but lose the accuracy mark. (Q says 3dp.)
2	(ii)		Saves a function evaluation	B1 **[1]**		Has to be a comment about function values.
2	(iii)		eg Setting the control on a gas fire to achieve a room temperature of 20C. Function could be $(temp–20)^2$. (This example shows that optimising can be used to "achieve".) Note that the domain cannot be time based ... i.e finding when something occurred. One cannot go back in time to take a reading!	B1 **[1]**	Optimisation with need to sample at discrete intervals.	"Deepest point in seabed" example seen. This is acceptable, assuming that depth soundings are taken at points, and ignoring the fact that the domain is two dimensional rather than one dimensional.

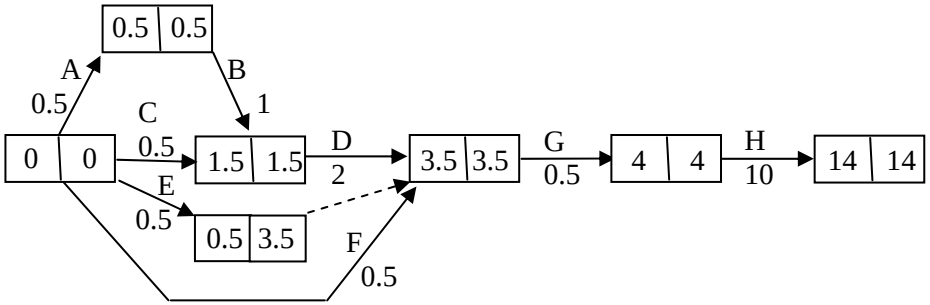
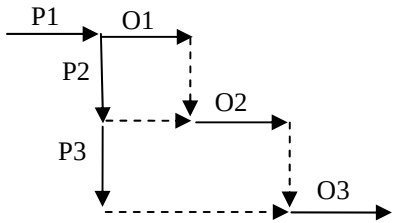
3	**(i)**		"is a subset of"  "shares at least one element with" 	M1 A1 M1 A1 **[4]**	directed graph on 3 vertices all correct undirected on 3 vertices all correct	Arcs must either have an arrow at each end. or no arrows.
3	**(ii)**		eg 	M1 A1 B1 B1 **[4]**	R subset of Q no other subsets P∩Q P∩Q' 	Allow area split in two, with third area. eg  If P and R shown intersecting then can score M1 A1 B0 B0.

Question			Answer	Marks	Guidance	
4	(i)		Let x be the number of type X motors produced. Let y be the number of type Y motors produced. $10x + 12y \leq 200$ $x \geq 5$ and $y \geq 5$ $0.5x + 0.3y \leq 7$	M1 A1 B1 B1 B1 **[5]**	adequate definition "number of"	Strict inequalities are equally OK
4	(ii)			B1 B1 B1 B1 **[4]**	inclined line inclined line x=5 and y=5 shading follow line errors if shape is 	The guidance level of accuracy throughout this question is ±0.25 on the x coordinate and ±0.25 on the y coordinate. (Look at (8,10) first.) Inaccurate sketch with axis intercepts given is OK.

Question			Answer	Marks	Guidance	
4	(iii)		Profit = 100X + 70Y	B1		
			(5,12.5) or (5,12) 1375 or 1340 (8,10) 1500 (11,5) 1450	M1	optimisation	either profit line or evaluating and comparing at their 3 appropriate points (OK if on graph)
			£1500 profit.	A1	1500 seen cao SC B1 for 1500 without the preceding M mark	
				[3]		
4	(iv)		Solution in range $\left(10 \pm \frac{1}{4},\ 6\frac{2}{3} \pm \frac{1}{4}\right) = \left(9.75 - 10{,}25,\ 6.41\dot{6} - 6.91\dot{6}\right)$	B1	cao	looking for $\left(10,\ 6\frac{2}{3}\right)$
			Identification of one of (9,7), (10,6) and (11,5).	B1	cao	
			Evaluation at all three of (9,7) (10,6) (11,5) **1390 1420 1450**	M1		
			So 11 of X and 5 of Y	A1	cao	
				[4]		

Question			Answer	Marks	Guidance	
5	(i)		eg 0–7 → double 8 → single 9 reject and re-draw	M1 A1 **[2]**	reject correct proportions	Rejection can be implied.
5	(ii)		eg 0–5 → double 6,7 → single 8,9 reject and re-draw	M1 A1 **[2]**	reject correct proportions	Rejection can be implied. Ignore rule for (4,0).
5	(iii)		e.g. day selection / doubles / singles / random number 1 5 0 2 4 1 5 double	M1 A1	allow 5 shown as used on RN list. selection	For the simulation M1's you need to see a random number being used with their rules
			3 3 2 9, 4 double	M1 A1	must show RN(s) explicitly new scenario seen explicitly, not implied by day 4 rule	Follow a candidate who manages correctly to go from (4,1) to (4,0). It will then gain M1 if it correctly goes to (3,1) on day 4, with A1 if shows no simulation needed.
			4 2 3 0 double 5 1 4	M1 A1	a correct day 4 rule selection and new scenario	rule must be seen needs RN explicit. Allow new scenario if seen in subsequent probability calculation.
			Probability of drawing a single bag on day 5 is now 4/6.	M1 A1 **[8]**	denominator = 6 numerator	Can be implied by 2/3 or 1/3 if correct for their simulation.

Question			Answer	Marks	Guidance
5	(iv)		4 simulations, each ending with 6 bags all scenarios correct	M1 A1 **[2]**	Condone one slip. Condone simulating at (4,0) if correctly done. 6 bags can be implied by probs of thirds or sixths.
5	(v)		Either averaging correct probabilities or sum of singles/30	M1 A1 **[2]**	Correct computation, but allow 1 slip or omission. Correct answer for their simulations.

Question			Answer	Marks	Guidance
6	(i) & (ii)		 Minimum completion time = 14 mins Critical activities ... A, B, D, G, H	M1 A1 A1 A1 A1 M1 A1 M1 A1 B1 B1 **[11]**	activity on arc at least 1 dummy for E and F precedences for D precedences for G rest eg. penalise multiple starts forward pass backward pass If OK at start of dummy. If there is no dummy then these two marks are not available.
6	(iii)		2 people	B1 **[1]**	
6	(iv)		1 person ... 15.5 mins	B1 **[1]**	
6	(v)		 time = 35.5 minutes	B1 B1 **[2]**	network time with small oven
6	(vi)		revised time = 26.5 minutes	B1 **[1]**	time with large oven

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4771 Decision Mathematics 1

General Comments

Many candidates found difficulty with this paper.

Comments on Individual Questions

1) This was a context-free application of one of the bedrock algorithms of D1, Dijkstra. It was intended to check the ability of candidates accurately to apply the algorithm. Many candidates either did not know the algorithm, or could not apply it correctly.

2) In the real world optimising is rarely a case of differentiating and setting to zero. Usually the function to be optimised is not known, and all that can be found are function values, often each at great expense in terms of money or time. In the real world functions are usually multivariate, but in the case of a univariate function Golden Section Search is very efficient. The question was about this.

   Six of the eight marks were for applying the algorithm. In this case, instead of experimentation to find function values, candidates had to evaluate a quadratic. Candidates were comfortable with this part of the question although some candidates lost a mark by not giving the required degree of accuracy, and some lost the same mark by giving values in surd form.

   A few candidates gained the difficult penultimate mark. Candidates did not need two evaluations on the second iteration, since they already had one of them from the first iteration. The use of an interval reduction factor of $1/\phi$ saves a function evaluation at each iteration of the algorithm. The algebra involved in deducing this is accessible, the modelling to produce that algebra is less so.

   It was thought that fewer candidates would succeed with the last mark, but in the event several suggested appropriate physical situations.

3) This graph theory question was well answered. It speaks well of candidates' abilities to deal with the abstract, which is an area which one hopes would be developed by GCE mathematics.

4) Part (i) of the LP question was concerned with formulation. Far too many candidates, if they remembered to define their variables, neglected that essential phrase "the **number** of ...".

   The graph was generally drawn well in part (ii).

   In part (iii) too many candidates failed to do the obvious in the optimisation, i.e. to evaluate at the three possible optimal points.

   In the revised optimisation (part (iv)) the issue of integer values needed to be addressed. This was not done well, but then it was not easy. The points that needed to be examined were (9,7), (10,6) and (11,5).

5) Candidates' attempts at parts (i) and (ii) were very disappointing. The need to reject and redraw whenever the number of possibilities is not 2, 5 or 10 (when using single-digit random numbers), was not well understood and the majority of candidates failed to collect these 4 marks.

In contrast part (iii) produced quite good marks, the key being to explain the simulations ... random number ... rule ... outcome.
Again, explanations were needed in parts (iv) and (v)

6) This was a fairly straightforward CPA question. A dummy was required in part (i) so that E and F did not share "i" and "j" events. Normally the method marks for forward and backward passes in part (ii) are awarded for handling joins and bursts respectively. In this case there was no burst (the initial node does not count as a burst), and the M mark for the backward pass was given for correctly handling the late "i" time for a dummy. Thus candidates forfeited 3 marks in total if they failed to use a dummy.

Parts (iii) and (iv) were straightforward, but many candidates failed to collect the marks. For instance, in part (iv) a common wrong answer was 15.5 mins.

Jim's availability needed to be allowed for in the precedence diagram in part (v).

GCE Mathematics (MEI)

			Max Mark	a	b	c	d	e	u
4751/01	(C1) MEI Introduction to Advanced Mathematics	Raw	72	57	50	44	38	32	0
		UMS	100	80	70	60	50	40	0
4752/01	(C2) MEI Concepts for Advanced Mathematics	Raw	72	54	48	42	36	31	0
		UMS	100	80	70	60	50	40	0
4753/01	(C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	60	53	47	41	34	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	65	57	50	43	36	0
		UMS	100	80	70	60	50	40	0
4755/01	(FP1) MEI Further Concepts for Advanced Mathematics	Raw	72	63	56	49	42	35	0
		UMS	100	80	70	60	50	40	0
4756/01	(FP2) MEI Further Methods for Advanced Mathematics	Raw	72	61	53	46	39	32	0
		UMS	100	80	70	60	50	40	0
4757/01	(FP3) MEI Further Applications of Advanced Mathematics	Raw	72	54	47	40	34	28	0
		UMS	100	80	70	60	50	40	0
4758/01	(DE) MEI Differential Equations with Coursework: Written Paper	Raw	72	63	57	51	45	39	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	58	50	42	34	27	0
		UMS	100	80	70	60	50	40	0
4762/01	(M2) MEI Mechanics 2	Raw	72	58	51	44	38	32	0
		UMS	100	80	70	60	50	40	0
4763/01	(M3) MEI Mechanics 3	Raw	72	63	56	50	44	38	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	54	46	38	30	23	0
		UMS	100	80	70	60	50	40	0
4767/01	(S2) MEI Statistics 2	Raw	72	61	55	49	43	38	0
		UMS	100	80	70	60	50	40	0
4768/01	(S3) MEI Statistics 3	Raw	72	58	51	44	38	32	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	53	47	42	37	32	0
		UMS	100	80	70	60	50	40	0
4772/01	(D2) MEI Decision Mathematics 2	Raw	72	56	50	44	39	34	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	50	44	38	33	27	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