

ADVANCED SUBSIDIARY GCE
MATHEMATICS (MEI)
Decision Mathematics 1

4771

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:

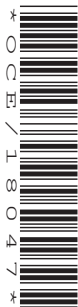
- Printed answer book 4771
- MEI Examination Formulae and Tables (MF2)

Other materials required:

- Scientific or graphical calculator

Monday 24 January 2011
Morning

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. 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.

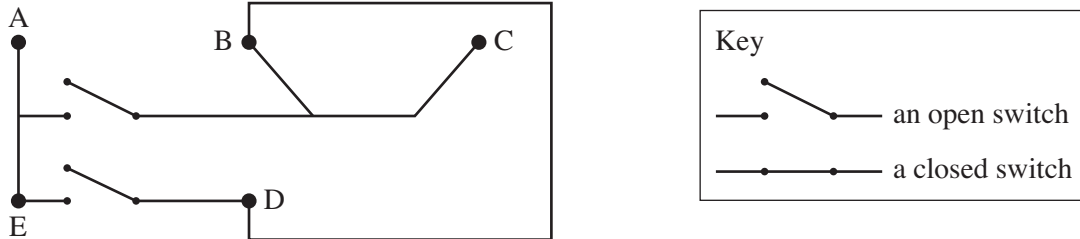
INSTRUCTIONS TO EXAMS OFFICER/INVIGILATOR

- Do not send this question paper for marking; it should be retained in the centre or destroyed.

Answer all questions in the Printed Answer Book provided.

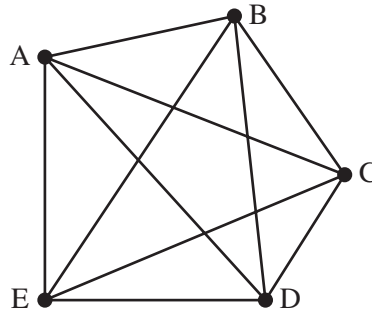
Section A (24 marks)

- 1 The diagram shows an electrical circuit with wires and switches and with five components, labelled A, B, C, D and E.



- (i) Draw a graph showing which vertices are connected together, either directly or indirectly, when the two switches remain open. [2]
- (ii) How many arcs need to be added to your graph when both switches are closed? [2]

The graph below shows which components are connected to each other, either directly or indirectly, for a second electrical circuit.



- (iii) Find the minimum number of arcs which need to be deleted to create two disconnected sets of vertices, and write down your two separate sets. [3]
- (iv) Explain why, in the second electrical circuit, it might be possible to split the components into two disconnected sets by cutting fewer wires than the number of arcs which were deleted in part (iii). [1]

- 2 King Elyias has been presented with eight flagons of fine wine. Intelligence reports indicate that at least one of the eight flagons has been poisoned. King Elyias will have the wine tasted by the royal wine tasters to establish which flagons are poisoned.

Samples for testing are made by using wine from one or more flagons. If a royal wine taster tastes a sample of wine which includes wine from a poisoned flagon, the taster will die. The king has to make a very generous payment for each sample tasted.

To minimise payments, the royal mathematicians have devised the following scheme:

Test a sample made by mixing wine from flagons 1, 2, 3 and 4.

If the taster dies, then test a sample made by mixing wine from flagons 5, 6, 7 and 8.

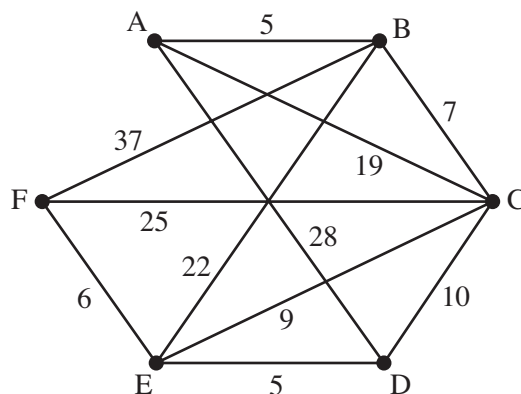
If the taster lives, then there is no poison in flagons 1, 2, 3 or 4. So there is poison in at least one of flagons 5, 6, 7 and 8, and there is no need to test a sample made by mixing wine from all four of them.

If the sample from flagons 1, 2, 3 and 4 contains poison, then test a fresh sample made by mixing wine from flagons 1 and 2, and proceed similarly, testing a sample from flagons 3 and 4 only if the taster of the sample from flagons 1 and 2 dies.

Continue, testing new samples made from wine drawn from half of the flagons corresponding to a poisoned sample, and testing only when necessary.

- (i) Record what happens using the mathematicians' scheme when flagon number 7 is poisoned, and no others. [4]
- (ii) Record what happens using the mathematicians' scheme when two flagons, numbers 3 and 7, are poisoned. [4]

- 3 The network shows distances between vertices where direct connections exist.



- (i) Use Dijkstra's algorithm to find the shortest distance and route from A to F. [6]
- (ii) Explain why your solution to part (i) also provides the shortest distances and routes from A to each of the other vertices. [1]
- (iii) Explain why your solution to part (i) also provides the shortest distance and route from B to F. [1]

Section B (48 marks)

4 The table shows the tasks involved in preparing breakfast, and their durations.

Task	Description	Duration (mins)
A	Fill kettle and switch on	0.5
B	Boil kettle	1.5
C	Cut bread and put in toaster	0.5
D	Toast bread	2
E	Put eggs in pan of water and light gas	1
F	Boil eggs	5
G	Put tablecloth, cutlery and crockery on table	2.5
H	Make tea and put on table	0.5
I	Collect toast and put on table	0.5
J	Put eggs in cups and put on table	1

- (i) Show the immediate predecessors for each of these tasks. [3]
- (ii) Draw an activity on arc network modelling your precedences. [3]
- (iii) Perform a forward pass and a backward pass to find the early time and the late time for each event. [4]
- (iv) Give the critical activities, the project duration, and the total float for each activity. [3]
- (v) Given that only one person is available to do these tasks, and noting that tasks B, D and F do not require that person's attention, produce a cascade chart showing how breakfast can be prepared in the least possible time. [3]

- 5 Viola and Orsino are arguing about which striker to include in their fantasy football team. Viola prefers Rocinate, who creates lots of goal chances, but is less good at converting them into goals. Orsino prefers Quince, who is not so good at creating goal chances, but who is better at converting them into goals.

The information for Rocinate and Quince is shown in the tables.

		Number of chances created per match							
		Rocinate				Quince			
Number		6	7	8	9	5	6	7	8
Probability		$\frac{1}{20}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{5}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{6}$

Probability of converting a chance into a goal	
Rocinate	Quince
0.1	0.12

- (i) Give an efficient rule for using 2-digit random numbers to simulate the number of chances created by Rocinate in a match. [3]
- (ii) Give a rule for using 2-digit random numbers to simulate the conversion of chances into goals by Rocinate. [1]
- (iii) Your Printed Answer Book shows the result of simulating the number of goals scored by Rocinate in nine matches. Use the random numbers given to complete the tenth simulation, showing which of your simulated chances are converted into goals. [3]
- (iv) Give an efficient rule for using 2-digit random numbers to simulate the number of chances created by Quince in a match. [3]
- (v) Your Printed Answer Book shows the result of simulating the number of goals scored by Quince in nine matches. Use the random numbers given to complete the tenth simulation, showing which of your simulated chances are converted into goals. [3]
- (vi) Which striker, if any, is favoured by the simulation? Justify your answer. [2]
- (vii) How could the reliability of the simulation be improved? [1]

[Question 6 is printed overleaf.]

- 6 A manufacturing company holds stocks of two liquid chemicals. The company needs to update its stock levels.

The company has 2000 litres of chemical A and 4000 litres of chemical B currently in stock. Its storage facility allows for no more than a combined total of 12000 litres of the two chemicals.

Chemical A is valued at £5 per litre and chemical B is valued at £6 per litre. The company intends to hold stocks of these two chemicals with a total value of at least £61000.

Let a be the increase in the stock level of A, in thousands of litres (a can be negative).

Let b be the increase in the stock level of B, in thousands of litres (b can be negative).

- (i) Explain why $a \geq -2$, and produce a similar inequality for b . [2]
- (ii) Explain why the value constraint can be written as $5a + 6b \geq 27$, and produce, in similar form, the storage constraint. [4]
- (iii) Illustrate all four inequalities graphically. [5]
- (iv) Find the policy which will give a stock value of exactly £61000, and will use all 12000 litres of available storage space. [2]
- (v) Interpret your solution in terms of stock levels, and verify that the new stock levels do satisfy both the value constraint and the storage constraint. [3]

BLANK PAGE

**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

**ADVANCED SUBSIDIARY GCE
MATHEMATICS (MEI)**
Decision Mathematics 1

4771

PRINTED ANSWER BOOK

Candidates answer on this printed answer book.

OCR supplied materials:

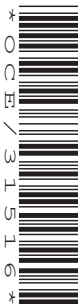
- Question paper 4771 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other materials required:

- Scientific or graphical calculator

**Monday 24 January 2011
Morning**

Duration: 1 hour 30 minutes



Candidate forename		Candidate surname	
-----------------------	--	----------------------	--

Centre number						Candidate number				
---------------	--	--	--	--	--	------------------	--	--	--	--

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. 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.

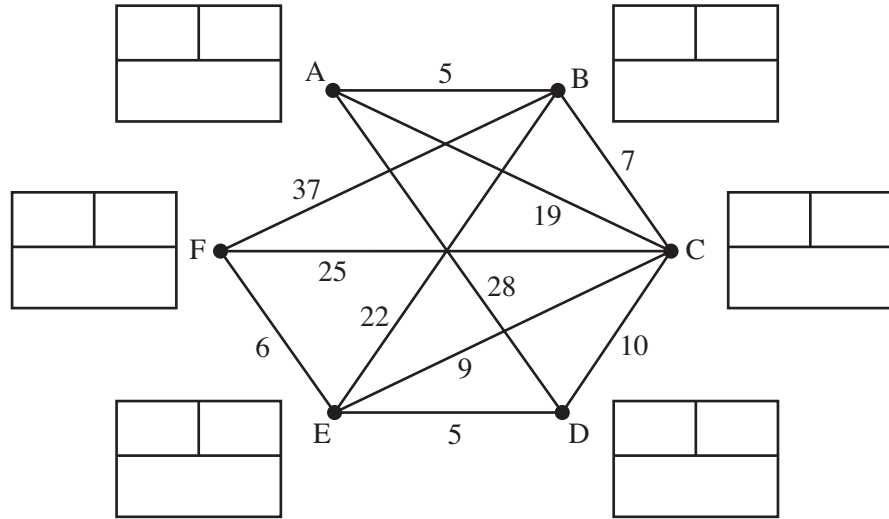
Section A (24 marks)

1 (i)	<p style="text-align: center;">A B C</p> <p style="text-align: center;">● ● ●</p> <p style="text-align: center;">E D</p> <p style="text-align: center;">● ●</p>
1 (ii)	<hr/> <hr/> <hr/> <hr/>
1 (iii)	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
1 (iv)	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

2 (i)	Test number	Sample from flacons	Result (D = dead, A = alive)
	1	1, 2, 3, 4	

2 (ii)	Test number	Sample from flacons	Result (D = dead, A = alive)
	1	1, 2, 3, 4	

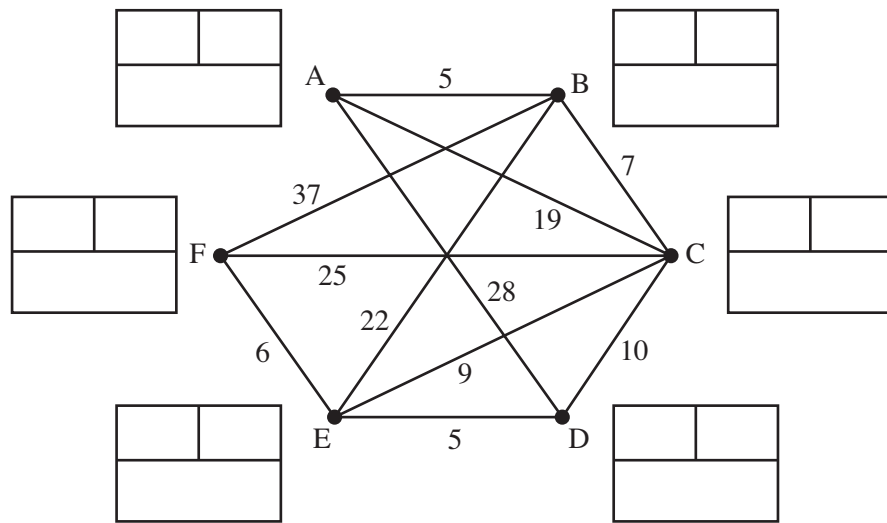
3 (i)



3 (ii)

3 (iii)

3 (i) SPARE COPY OF DIAGRAM



PLEASE DO NOT WRITE IN THIS SPACE

4 (iv)																							
	Critical activities :																						
	Duration:																						
	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 10%;">task:</td> <td style="width: 10%;">A</td> <td style="width: 10%;">B</td> <td style="width: 10%;">C</td> <td style="width: 10%;">D</td> <td style="width: 10%;">E</td> <td style="width: 10%;">F</td> <td style="width: 10%;">G</td> <td style="width: 10%;">H</td> <td style="width: 10%;">I</td> <td style="width: 10%;">J</td> </tr> <tr> <td>float:</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	task:	A	B	C	D	E	F	G	H	I	J	float:										
task:	A	B	C	D	E	F	G	H	I	J													
float:																							

4 (v)	<div style="border: 1px solid black; height: 150px; width: 100%; margin-bottom: 20px;"></div> <p>SPARE COPY OF GRID</p> <div style="border: 1px solid black; height: 150px; width: 100%;"></div>
--------------	---

5 (i)																					
5 (ii)																					
5 (iii)	<table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="padding: 5px;">Match number</th> <th style="padding: 5px;">Goals scored by Rocinate</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">1</td><td style="text-align: center;">3</td></tr> <tr><td style="text-align: center;">2</td><td style="text-align: center;">0</td></tr> <tr><td style="text-align: center;">3</td><td style="text-align: center;">1</td></tr> <tr><td style="text-align: center;">4</td><td style="text-align: center;">0</td></tr> <tr><td style="text-align: center;">5</td><td style="text-align: center;">0</td></tr> <tr><td style="text-align: center;">6</td><td style="text-align: center;">1</td></tr> <tr><td style="text-align: center;">7</td><td style="text-align: center;">1</td></tr> <tr><td style="text-align: center;">8</td><td style="text-align: center;">2</td></tr> <tr><td style="text-align: center;">9</td><td style="text-align: center;">1</td></tr> </tbody> </table>	Match number	Goals scored by Rocinate	1	3	2	0	3	1	4	0	5	0	6	1	7	1	8	2	9	1
	Match number	Goals scored by Rocinate																			
	1	3																			
	2	0																			
	3	1																			
	4	0																			
	5	0																			
	6	1																			
	7	1																			
	8	2																			
9	1																				
Match number 10																					
Random number for simulating the number of chances created = 37																					
Number of simulated chances = _____																					
Random numbers for simulating the conversion of chances into goals:																					
43 2 47 14 33 72 32 96 59																					
Number of simulated goals = _____																					

5 (iv)

5 (v)

Match number	Goals scored by Quince
1	3
2	1
3	1
4	1
5	1
6	0
7	0
8	1
9	1

Match number 10

Random number for simulating the number of chances created = 54

Number of simulated chances = _____

Random numbers for simulating the conversion of chances into goals:

72 42 11 89 56 85 5 72 91

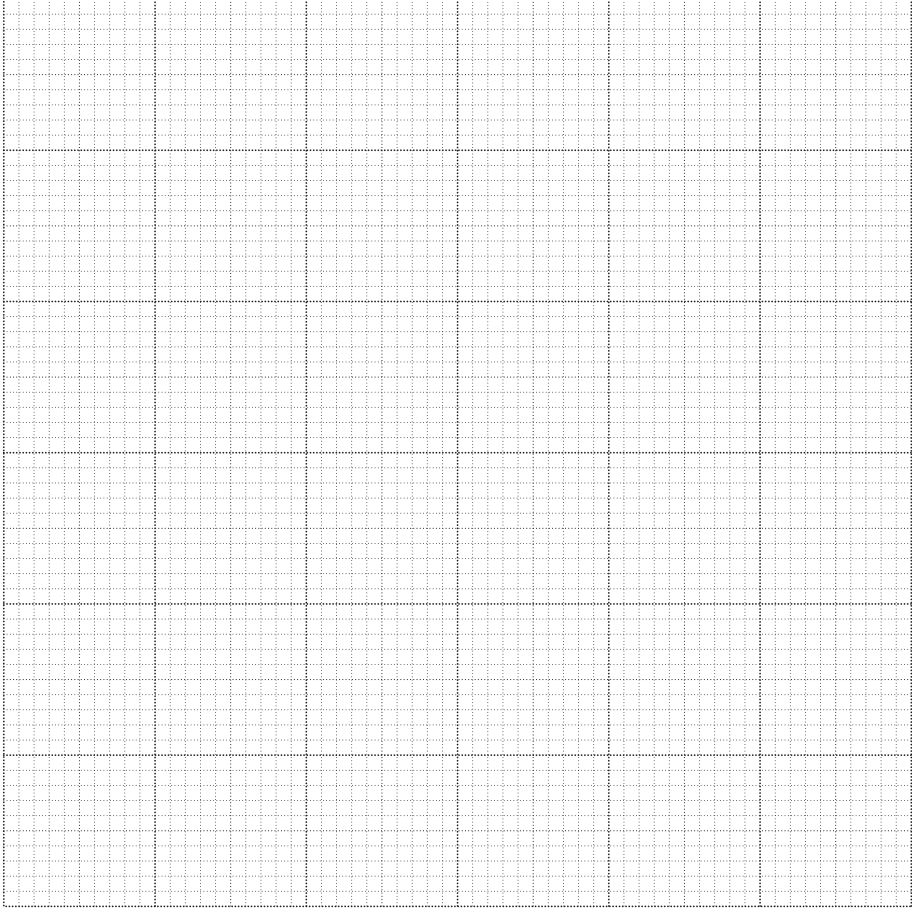
Number of simulated goals = _____

5 (vi)

5 (vii)

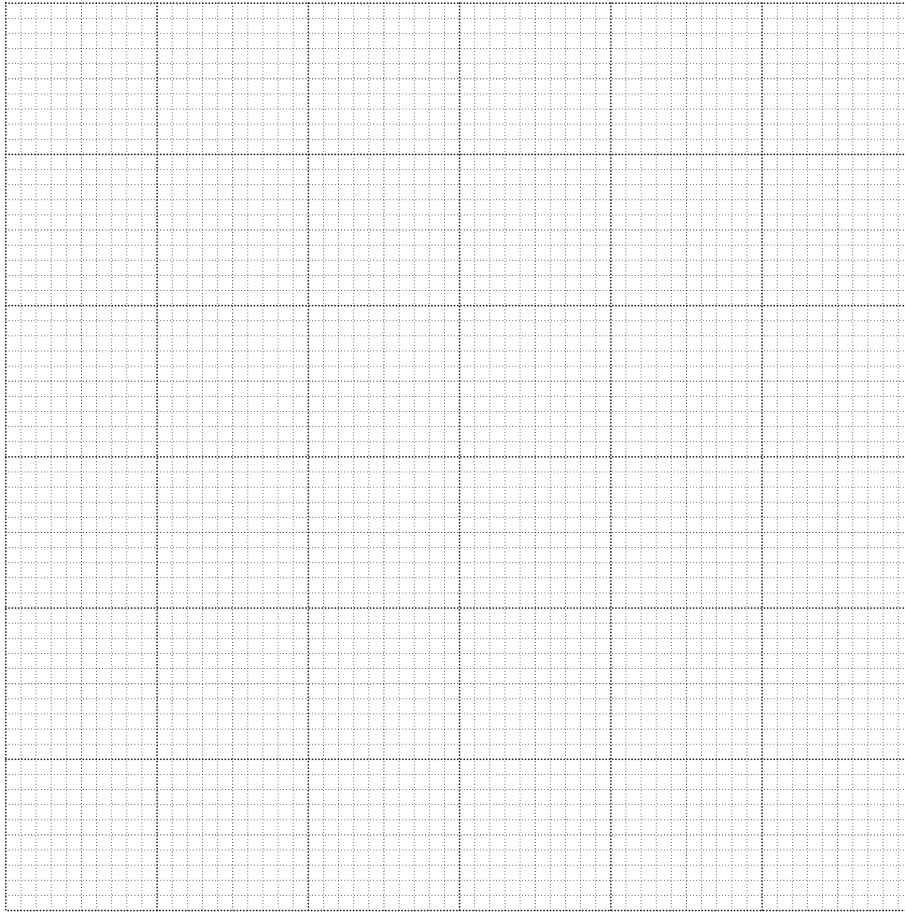
6 (i)	

6 (ii)	

6 (iii)	

A SPARE COPY OF THIS GRAPH PAPER CAN BE FOUND ON PAGE 12.

6 (iii)	continued
6 (iv)	
6 (v)	

SPARE COPY OF GRAPH PAPER FOR 6 (iii)**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

Mathematics (MEI)

Advanced Subsidiary GCE

Unit 4771: Decision Mathematics 1

Mark Scheme for January 2011

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils 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.

© OCR 2011

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

Marking instructions for GCE Mathematics (MEI): Decision strand

1. You are advised to work through the paper yourself first. Ensure you familiarise yourself with the mark scheme before you tackle the practice scripts.
2. You will be required to mark ten practice scripts. This will help you to understand the mark scheme and will not be used to assess the quality of your marking. Mark the scripts yourself first, using the annotations. Turn on the comments box and make sure you understand the comments. You must also look at the definitive marks to check your marking. If you are unsure why the marks for the practice scripts have been awarded in the way they have, please contact your Team Leader.
3. When you are confident with the mark scheme, mark the ten standardisation scripts. Your Team Leader will give you feedback on these scripts and approve you for marking. (If your marking is not of an acceptable standard your Team Leader will give you advice and you will be required to do further work. You will only be approved for marking if your Team Leader is confident that you will be able to mark candidate scripts to an acceptable standard.)
4. Mark strictly to the mark scheme. If in doubt, consult your Team Leader using the messaging system within *scoris*, by email or by telephone. Your Team Leader will be monitoring your marking and giving you feedback throughout the marking period.

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.

5. 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.

6. 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.
7. 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.

8. 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.
9. **Rules for crossed out and/or replaced work**

If work is crossed out and not replaced, examiners should mark the crossed out work if it is legible.

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 two or more attempts are made at a question, and just one is not crossed out, examiners should ignore the crossed out work and mark the work that is not crossed out.

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.

10. 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.

11. 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.

12. For answers scoring no marks, you must either award NR (no response) or 0, as follows:

Award NR (no response) if:

- Nothing is written at all in the answer space
- There is a comment which does not in any way relate to the question being asked ("can't do", "don't know", etc.)
- There is any sort of mark that is not an attempt at the question (a dash, a question mark, etc.)

The hash key [#] on your keyboard will enter NR.

Award 0 if:

- There is an attempt that earns no credit. This could, for example, include the candidate copying all or some of the question, or any working that does not earn any marks, whether crossed out or not.

13. The following abbreviations may be used in this mark scheme.

M1	method mark (M2, etc, is also used)
A1	accuracy mark
B1	independent mark
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
ft	follow through
isw	ignore subsequent working
oe	or equivalent
rot	rounded or truncated

sc	special case
soi	seen or implied
www	without wrong working

14. Annotating scripts. The following annotations are available:

✓ and ✖

BOD Benefit of doubt

FT Follow through

ISW Ignore subsequent working (after correct answer obtained)

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

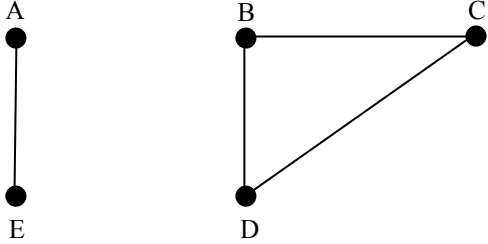
Highlighting is also available to highlight any particular points on a script.

15. The comments box will be used by the Principal Examiner to explain his or her marking of the practice scripts for your information. Please refer to these comments when checking your practice scripts.

Please do not type in the comments box yourself. Any questions or comments you have for your Team Leader should be communicated by the *scoris* messaging system, e-mail or by telephone.

16. Write a brief report on the performance of the candidates. Your Team Leader will tell you when this is required. The Assistant Examiner's Report Form (AERF) can be found on the Cambridge Assessment Support Portal. This should contain notes on particular strengths displayed, as well as common errors or weaknesses. Constructive criticisms of the question paper/mark scheme are also appreciated.
17. Link Additional Objects with work relating to a question to those questions (a chain link appears by the relevant question number) – see *scoris* assessor Quick Reference Guide page 19-20 for instructions as to how to do this – this guide is on the Cambridge Assessment Support Portal and new users may like to download it with a shortcut on your desktop so you can open it easily! For AOs containing just formulae or rough working not attributed to a question, tick at the top to indicate seen but not linked. When you submit the script, *scoris* asks you to confirm that you have looked at all the additional objects. Please ensure that you have checked all Additional Objects thoroughly.
18. The schedule of dates for the marking of this paper is displayed under 'OCR Subject Specific Details' on the Cambridge Assessment Support Portal. It is vitally important that you meet these requirements. If you experience problems that mean you may not be able to meet the deadline then you must contact your Team Leader without delay.

1.

<p>(i)</p> 	<p>M1 A1</p>	<p>M1 any and only 3 of the 4 A1 all</p>
<p>(ii) 6</p>	<p>M1 attempt at complete connectivity A1</p>	<p>M1 5, 6 or 7 A1 6</p>
<p>(iii) e.g. 4 arcs and (e.g.) {A}, {B, C, D, E}</p>	<p>B1 B1 B1</p>	<p>4 ... set of 1 ... disjoint set of 4</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>SC M1 6 arcs A1 appropriate sets ... disjoint of size 2 and 3</p> </div>
<p>(iv) Reference to parts (i) and (ii), in reverse – or similar</p>	<p>B1</p>	

2.

(i)	Test number	Sample drawn from flagons numbered	Result (D = dead, A = alive)	B1 B1 B1 B1	cao cao ... allow extra second line of 5678 D, but with -1 cao cao
	1	1, 2, 3, 4	A		
	2	5, 6	A		
	3	7	D		
	4	8	A		
(ii)	Test number	Sample drawn from flagons numbered	Result (D = dead, A = alive)	B1 B1 B1 1,2 3 4 B1 5,6 7 8	cao cao award the last two B1s only for contiguous blocks of 3 tests from line 3 allow extraneous lines but -1 once only, and only from the last two B1s
	1	1, 2, 3, 4	D		
	2	5, 6, 7, 8	D		
	3	1, 2	A		
	4	3	D		
	5	4	A		
	6	5, 6	A		
	7	7	D		
	8	8	A		

4.

(i)

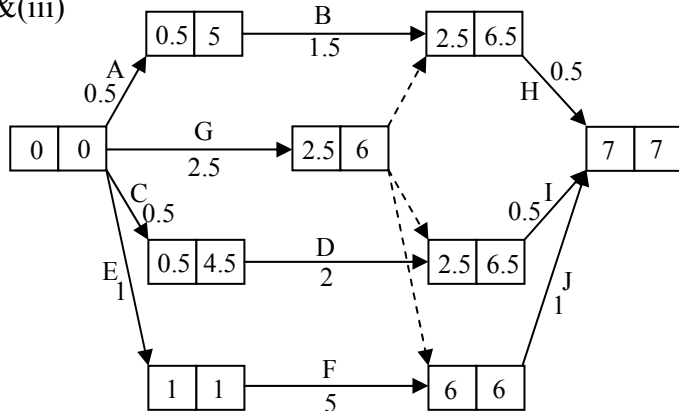
Task	Description	Duration (mins)	Immediate predecessor(s)
A	Fill kettle and switch on	0.5	—
B	Boil kettle	1.5	A
C	Cut bread and put in toaster	0.5	—
D	Toast bread	2	C
E	Put eggs in pan of water and light gas	1	—
F	Boil eggs	5	E
G	Put tablecloth, cutlery and crockery on table	2.5	—
H	Make tea and put on table	0.5	B; G
I	Collect toast and put on table	0.5	D; G
J	Put eggs in cups and put on table	1	F; G

B1 A, C, E and G

B1 B, D and F

B1 H, I and J

(ii)&(iii)



M1 activity-on-arc

A1 A, G, C, E,
B, D, F

A1 H, I, J

M1 A1 forward pass

M1 A1 backward pass

no follow through
no multiple starts

no multiple ends

√ but no follow of activity-on-node
√ ditto

(iv) critical activities: E; F; J
duration: 7 minutes

task: A B C D E F G H I J
float: 4.5 4.5 4 4 0 0 3.5 4 4 0

B1

B1

B1

cao

cao

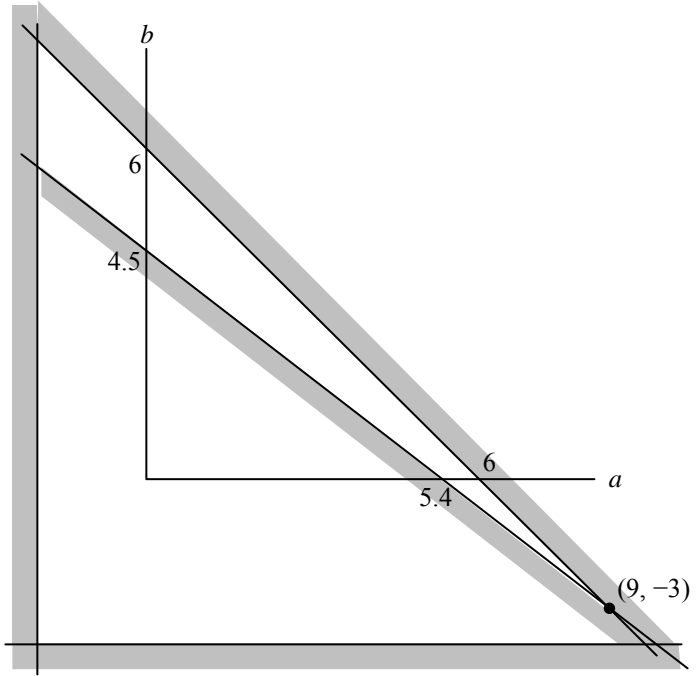
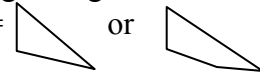

cao blank=0

<p>(v) e.g.</p>	<p>M1 cascade or condensed cascade</p> <p>A1 activities other than B, D and F non-overlapping</p> <p>A1 correctly finish in 7</p>	<p>need to have 9 or 10 activities</p> <p>E C A G H I J</p> <p>cao</p>
-----------------	---	--

5.

<p>(i) e.g. 00–04 6 05–29 7 30–79 8 80–99 9</p>	<p>M1 rule using 2-digit nos A1 correct proportions A1 efficient</p>	
<p>(ii) e.g. 00–09 goal 10–99 no goal</p>	<p>B1</p>	<p>complete rule required</p>
<p>(iii) e.g. 8 0 1 0 0 0 0 0 0 so 1 goal</p>	<p>B1 B1 B1</p>	<p>√ rule (i) √ need to see which are converted ... their 8 and rule (ii) √ their 8 and rule (ii) ... ignore previous line</p>
<p>(iv) e.g. 00–31 5 32–63 6 64–79 7 80–95 8 96–99 reject and redraw</p>	<p>M1 2 or more rejected A1 correct proportions A1 efficient</p>	<p>allow part (iv) if seen elsewhere 3 or 4 rejected</p>
<p>(v) e.g. 6 0 0 1 0 0 0 so 1 goal</p>	<p>B1 M1 A1</p>	<p>in part (v) below expect either 00–11 or 88–99 for goal any other rule must be declared to score marks √ rule (iv) √ their 6 ... need to see which are converted √</p>
<p>(vi) Each scored 10 goals. Nothing to choose between them.</p>	<p>M1 A1</p>	<p>goals scored one, the other or indifferent, depending on goals scored</p>
<p>(vii) More repetitions</p>	<p>B1</p>	<p>“greater number of random numbers” → 0 “more accurate data” → 0 Also no “or”s! 3-digit RNs → 0</p>

6.

<p>(i) Thousands of litres of A in stock = 2 $b \geq -4$</p>	<p>B1 B1</p>	<p>cao</p>
<p>(ii) $5(a+2) + 6(b+4) \geq 61$ $(a+2) + (b+4) \leq 12$ giving $a + b \leq 6$</p>	<p>M1 A1 M1 A1</p>	<p>watch for fluke</p>
<p>(iii)</p> 	<p>B4 lines B1 shading</p>	<p>√ their negative gradient stock line √ shape =  or </p>
<p>(iv) Increase stock levels of A by 9000 litres. Reduce stock levels of B by 3000.</p>	<p>B1 B1</p>	<p>Give the marks for 9000, -3000, or equivalent ± 200 litres on both</p>
<p>(v) New stock levels are 11000 of A and 1000 of B. $5 \times 11000 + 6 \times 1000 = 61000$ $11000 + 1000 = 12000$</p>	<p>B1 B1 B1</p>	<p>√ (iv) SC correct answer from nowhere OK Allow comment only for the “fully stocked” B1.</p>

4771 Decision Mathematics 1

General Comments

Candidates found this paper difficult. All questions contained routine applications, but all questions also contained elements which challenged candidates to think and to consider what one would expect really in Decision Mathematics.

Of course, it is always very difficult to think clearly. It is the skill which marks out good mathematicians. Those not so good at it were particularly caught out when explanations were required, as in parts 1(iv), 3(iii), 3(iv), 5(vi), 6(i) and 6(ii) however, literacy and mathematics go hand-in-glove, both depending on that elusive clarity of thought.

Comments on Individual Questions

Q 1 This question explored the relationship between electrical circuits and corresponding connectivity graphs. Many candidates did not absorb or understand the phrase “either directly or indirectly”, which was crucial to the question. This led to many errors in parts (i) and (ii).

Part (iii) was entirely graphical, and it was extremely disappointing to find the majority of candidates splitting the graph into sets of two and three vertices by deleting 6 arcs. Some even pondered on deleting the 4 arcs attached to a vertex and decided against doing so since they could not conceive of a single vertex as constituting a set.

Successful answers to part (iv) required reference either to the distinction between direct and indirect connectivity, or to the distinction between arcs and wires. This is representative of the underlying ethos of Decision Maths. We are modelling, and we need always to be able to distinguish between the model and reality. Candidates should be alert to the language which indicates this distinction, in this case “wires” and “arcs”.

Mention must be made of the significant number of candidates in part (iv) who tried to install switches, arguing that opening switches did not constitute cutting wires.

Q 2 This question focussed on testing the ability of candidates to follow instructions. The majority were found wanting, their solutions incurring unnecessary tests and costs.

Q 3 Part (i) was entirely routine, and potentially well-rewarded. It was very disappointing that so many candidates fared so badly with it. For instance, many candidates, inexplicably, labelled vertex E correctly, but then moved straight on to F, forgetting to consider D. Even more candidates neglected altogether to answer the question, or only answered one part of it, route or distance. Echoing comments above, many seemed unable to distinguish between “route” and “distance”.

Part (ii) saw the weakest set of answers to any part of the paper. Very few correct explanations were seen. Popular misconceptions included “To find the shortest route to F we have to find shortest route to all other vertices” and “The route to F visits all other vertices” ... it doesn't! Given the difficulty which many candidates had in expressing themselves, it was often difficult to distinguish between those who thought that all other vertices were always labelled by Dijkstra, and those who correctly observed that on this occasion all other vertices happened to have been labelled. For instance, “It is necessary to visit all other vertices to find the shortest route to F”.

Rather more candidates were successful in gaining the mark in part (iii), some very succinctly, e.g. “B is in the shortest path from A to F”. Some candidates were keen to point out that B was the second vertex labelled (true), and is therefore in all shortest

paths (not true). It was sometimes difficult to distinguish between that answer and answers pointing out that B is the second vertex on the shortest path from A to F, which of course did earn the mark.

- Q 4** Most candidates showed some ability to identify precedences, although as ever, “immediate” predecessors created some difficulties. Parts (ii), (iii) and (iv) were routine, but still caused some candidates problems. Only about half were able to produce a precedence diagram which was correct in all respects, most failing with aspects of H, I and J. Surprisingly often, arithmetic errors were made on the backward pass, particularly with 6.5-2 and with 6.5-1.5. The published markscheme shows a compressed version of a cascade chart for part (v). This is acceptable, since some find it easier to produce. Many candidates' efforts were virtually illegible after scanning ... candidates really **MUST** ensure that their work is clear. Some candidates omitted activities B, D and F, which was not acceptable ... they did not require resource, but they were needed for the precedence structure. Many solutions did not focus first on the critical path, started E late, and failed to finish in 7 minutes. Candidates did not seem to notice this.
- Q 5** Most candidates were able to produce acceptable rules in parts (i), (ii) and (iv), although every anticipated error was seen. Also as anticipated, about half of the candidates failed to answer the question in parts (iii) and (v), ignoring the injunction “showing which of your simulated chances are converted into goals”. Many of those who did show which, and many who did not (there was evidence), failed to do the simulation correctly. They used all of the provided random numbers instead of the number needed, i.e. simulating 9 chances in each case instead of the numbers of chances determined earlier. Part (vi) provided a stark example of the criticism voiced above ... lack of clarity. One could imagine most of the candidates being able to debate the relative merits of creating many goal scoring chances but accepting few, against creating fewer chances but being better able to convert them. But they were required to compare goals scored ... that is what the simulation was about! In part (vii) candidates who talked about “using more random numbers” were not making themselves clear. More repetitions (correct answer) require more random numbers, but so, in a different sense, does using 3-digit random numbers. The latter is incorrect since it does not answer the question ... it would affect the efficiency but not the reliability.
- Q 6** There were many inadequate answers seen for parts (i) and (ii). The examiners require just short and clear comments. Paradoxically, candidates were more at home with the $5a + 6b \geq 27$ than with other parts, and some good algebraic reasoning was seen there, as per in the markscheme, i.e. $5(a+2) + 6(b+4) \geq 61$. Some good verbal explanations were also seen, and were equally acceptable. Quite a large number of good answers were seen to 6(iii). The most common, and distressing error, was to see scales marked and used on $b = -4$ instead of on $b = 0$ (the a -axis), and on $a = -2$ instead of on $a = 0$ (the b -axis). This revealed a misunderstanding of the most fundamental of mathematical concepts involving the use of graphs. Some candidates were able, by hook or by crook, to recover inadequate earlier work in parts (iv) and (v), and this was allowed.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity



OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553