OCR

Friday 6 June 2014 – Afternoon

A2 GCE MATHEMATICS (MEI)

4772/01 Decision Mathematics 2

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4772/01
- 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 bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

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 **16** pages. The Question Paper consists of **8** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

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

1 Keith is wondering whether or not to insure the value of his house against destruction. His friend Georgia has told him that it is a waste of money. Georgia argues that the insurance company sets its premiums (how much it charges for insurance) to take account of the probability of destruction, plus an extra fee for its profit. Georgia argues that house-owners are, on average, simply paying fees to the insurance company.

Keith's house is valued at £400 000. The annual premium for insuring its value against destruction is £100. Past statistics show that the probability of destruction in any one year is 0.0002.

(i) Draw a decision tree to model Keith's decision and the possible outcomes. **[6]**

(ii) Compute Keith's EMV and give the course of action which corresponds to that EMV. **[2]**

(iii) What would be the insurance premium if there were no fee for the insurance company? **[1]**

For the remainder of the question the insurance premium is still £100.

Suppose that, instead of EMV, Keith uses the utility function $utility = (money)^{0.5}$.

(iv) Compute Keith's utility and give his corresponding course of action. **[3]**

Keith suspects that it may be the case that he lives in an area in which the probability of destruction in a given year, p, is not 0.0002.

(v) Draw a decision tree, using the EMV criterion, to model Keith's decision in terms of p, the probability of destruction in the area in which Keith lives. **[1]**

(vi) Find the value of p which would make it worthwhile for Keith to insure his house using the EMV criterion. **[2]**

(vii) Explain why Keith may wish to insure even if p is less than the value which you found in part **(vi)**. **[1]**

2 **(a)** A national Sunday newspaper runs a "You are the umpire" series, in which questions are posed about whether a batsman in cricket is given "out", and why, or "not out". One Sunday the readers were told that a ball had either hit the bat and then the pad, or had missed the bat and hit the pad; the umpire could not be sure which. The ball had then flown directly to a fielder, who had caught it.

The LBW (leg before wicket) rule is complicated. The readers were told that this batsman should be given out (LBW) if the ball had not hit the bat. On the other hand, if the ball had hit the bat, then he should be given out (caught). Readers were asked what the decision should be.

The answer given in the newspaper was that this batsman should be given not out because the umpire could not be sure that the batsman was out (LBW), and could not be sure that he was out (caught).

(i) Rachel thinks that the answer given in the newspaper article is not sensible. Give a verbal argument why Rachel might think that the batsman should be given out. **[3]**

Rachel tries to formalise her argument. She defines four simple propositions.

o: "The batsman is given out."
lb: "The batsman is given out (LBW)."
c: "The batsman is given out (caught)."
b: "The ball hit the bat."

(ii) An implication of the batsman not being out (LBW) is that the ball has hit the bat. Write this down in terms of Rachel's propositions. **[1]**

(iii) Similarly, write down the implication of the batsman not being out (caught). **[1]**

(iv) Using your answers to parts **(ii)** and **(iii)** write down the implication of a batsman being not out, in terms of b and $\sim \mathrm{b}$.
[You may assume that if $\mathrm{w} \Rightarrow \mathrm{y}$ and $\mathrm{x} \Rightarrow \mathrm{z}$, then $(\mathrm{w} \wedge \mathrm{x}) \Rightarrow (\mathrm{y} \wedge \mathrm{z})$.] **[1]**

(v) By writing down the contrapositive of your implication from part **(iv)**, produce an implication which supports Rachel's argument. **[2]**

(b) A classroom rule has been broken by either Anja, Bobby, Catherine or Dimitria, or by a subset of those four. The teacher knows that Dimitria could not have done it on her own.

Let a be the proposition "Anja is guilty", and similarly for b, c and d.

(i) Express the teacher's knowledge as a compound proposition. **[1]**

Evidence emerges that Bobby and Catherine were elsewhere at the time, so they cannot be guilty. This can be expressed as the compound proposition $\sim (b \vee c)$.

(ii) Construct a truth table to show the truth values of the compound proposition given by the conjunction of the two compound propositions, one from part **(i)** and one given above. **[4]**

(iii) What does your truth table tell you about who is guilty? **[3]**

3 Three products, A, B and C are to be made.

Three supplements are included in each product. Product A has 10 g per kg of supplement X, 5 g per kg of supplement Y and 5 g per kg of supplement Z.

Product B has 5 g per kg of supplement X, 5 g per kg of supplement Y and 3 g per kg of supplement Z.

Product C has 12 g per kg of supplement X, 7 g per kg of supplement Y and 5 g per kg of supplement Z.

There are 12 kg of supplement X available, 12 kg of supplement Y, and 9 kg of supplement Z.

Product A will sell at £7 per kg and costs £3 per kg to produce. Product B will sell at £5 per kg and costs £2 per kg to produce. Product C will sell at £4 per kg and costs £3 per kg to produce.

The profit is to be maximised.

(i) Explain how the initial feasible tableau shown in Fig. 3 models this problem. **[6]**

P	a	b	c	s1	s2	s3	RHS
1	–4	–3	–1	0	0	0	0
0	10	5	12	1	0	0	12000
0	5	5	7	0	1	0	12000
0	5	3	5	0	0	1	9000

Fig. 3

(ii) Use the simplex algorithm to solve this problem, and interpret the solution. **[8]**

(iii) In the solution, one of the basic variables appears at a value of 0. Explain what this means. **[1]**

There is a contractual requirement to provide at least 500 kg of product A.

(iv) Show how to incorporate this constraint into the initial tableau ready for an application of the two-stage simplex method.

Briefly describe how the method works. You are **not** required to perform the iterations. **[5]**

4 John is designing a hot water system for his new house. The vertices on the network in Fig. 4 represe[illegible] positions for 6 hot water taps. The arcs represent possible connections between taps. The weights represent the lengths in metres of pipes that would be needed to connect the taps.

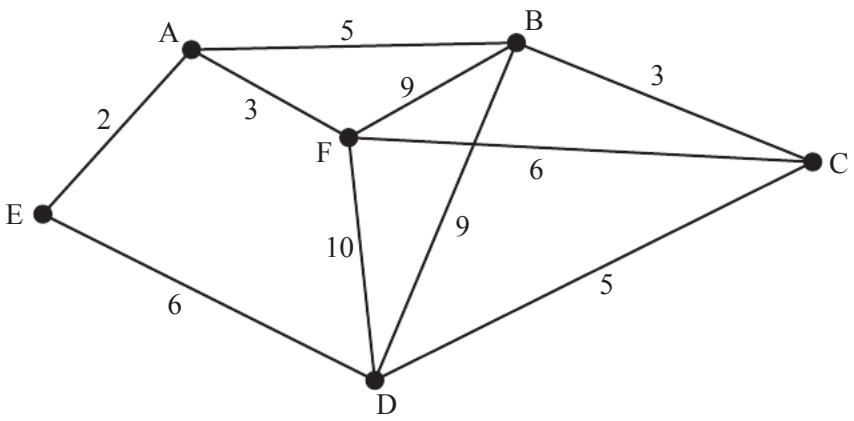

Fig. 4

(a) John wants to position the hot water cylinder so that the maximum distance from it to a hot tap is as small as possible.

(i) Use Dijkstra's algorithm repeatedly to find the complete network of shortest distances for the network of hot taps and pipes. **[7]**

(ii) Complete the matrix of shortest distances given in your answer book. **[2]**

(iii) Use your matrix to find the best vertex for John to choose for the hot water cylinder, explaining how you found it. **[3]**

(iv) Using your answer to part **(ii)**, show that there is no point on the arc AB which represents a better position for the hot water cylinder than vertex A or vertex B. **[1]**

(b) Alongside each hot tap there is a cold tap. Fig. 4 also represents the network for the cold taps. John wants to connect the cold taps with one run of pipe with no branches.

(i) Starting at vertex A in Fig. 4, apply the nearest neighbour algorithm to find a Hamilton cycle. Now delete the longest arc in that cycle to find a possible way for John to connect his cold taps. Give your connections and their total length. **[3]**

(ii) Repeat part **(b) (i)** for the other starting vertices, where possible, and give the best connector that you have found. **[4]**

END OF QUESTION PAPER

OCR

Friday 6 June 2014 – Afternoon

A2 GCE MATHEMATICS (MEI)

4772/01 Decision Mathematics 2

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Candidate forename		Candidate surname	

Centre number						Candidate number				

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1 (i)	

1 (ii)	
1 (iii)	
1 (iv)	

1 (v)	
1 (vi)	
1 (vii)	

2 (a)(i)	
2 (a)(ii)	
2 (a)(iii)	
2 (a)(iv)	
2 (a)(v)	

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

3 (i)

3 (ii)

P	a	b	c	s1	s2	s3	RHS
1	–4	–3	–1	0	0	0	0
0	10	5	12	1	0	0	12 000
0	5	5	7	0	1	0	12 000
0	5	3	5	0	0	1	9000

P	a	b	c	s1	s2	s3	RHS

P	a	b	c	s1	s2	s3	RHS

(answer space continued on next page)

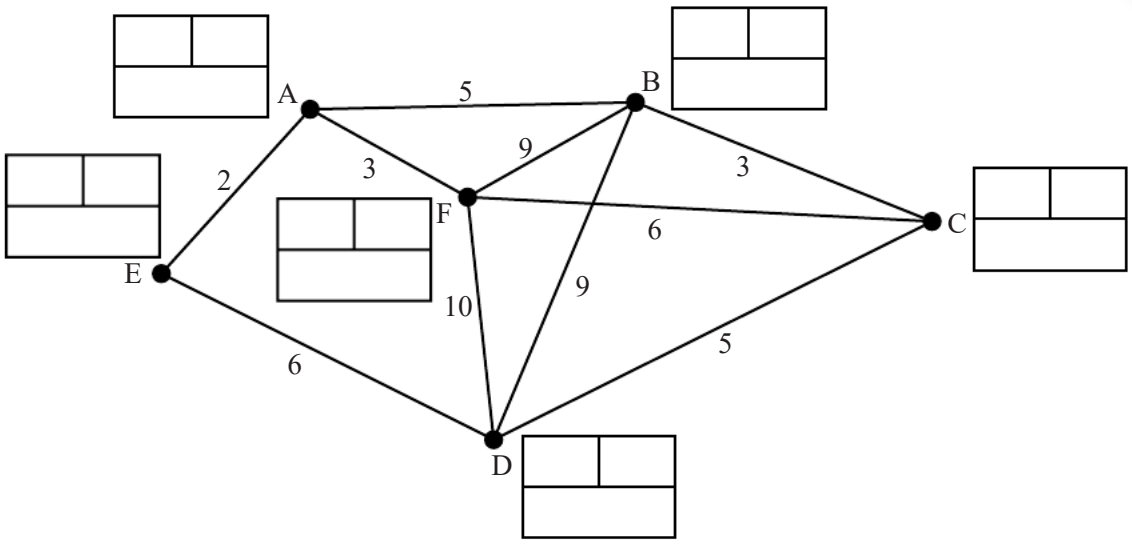
3 (ii) **(continued)**

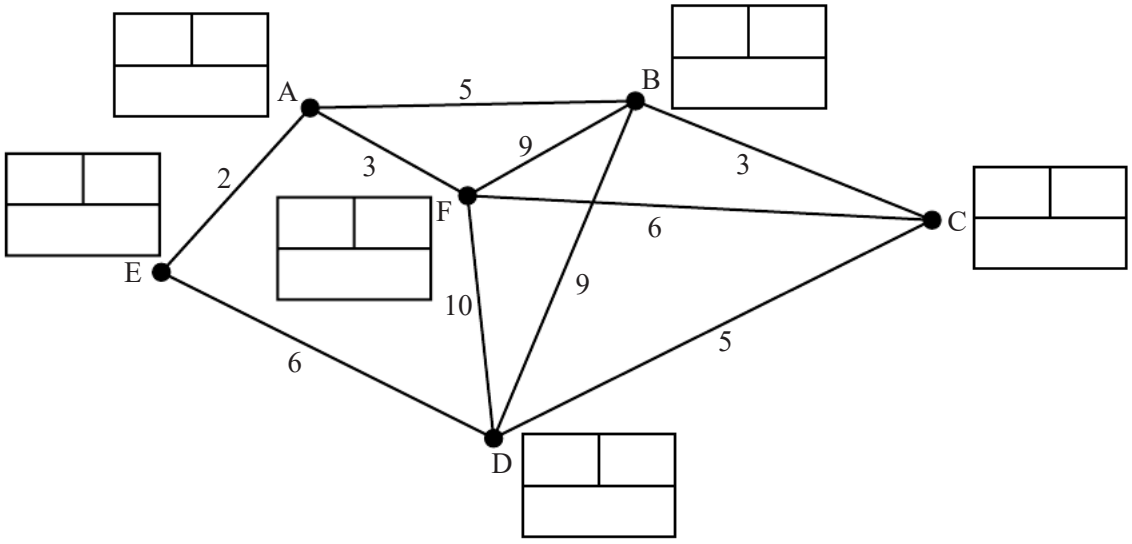
P	a	b	c	s1	s2	s3	RHS

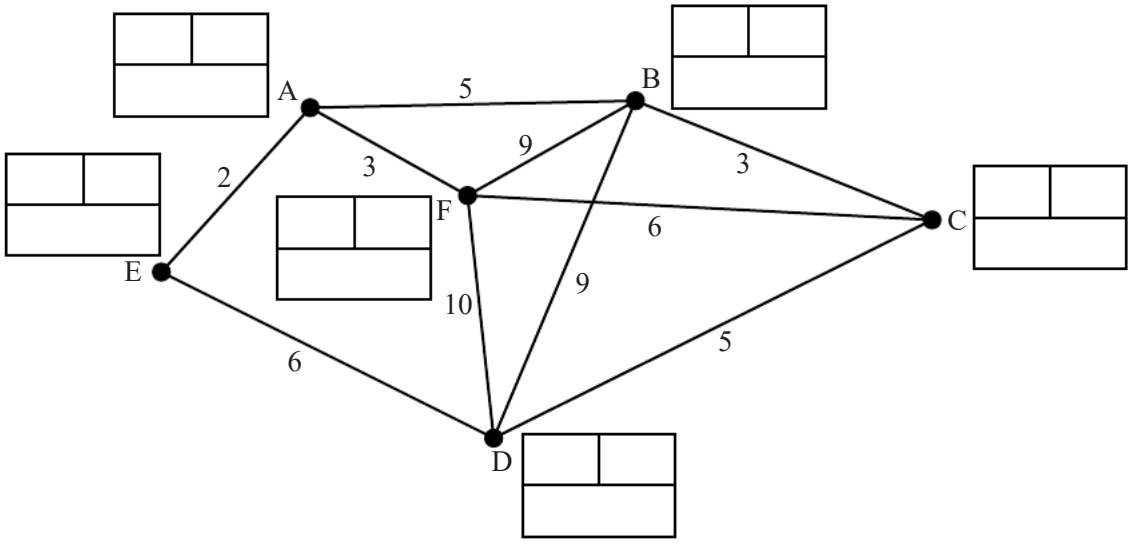
3 (iii)

3 (iv)

4 (a)(i)

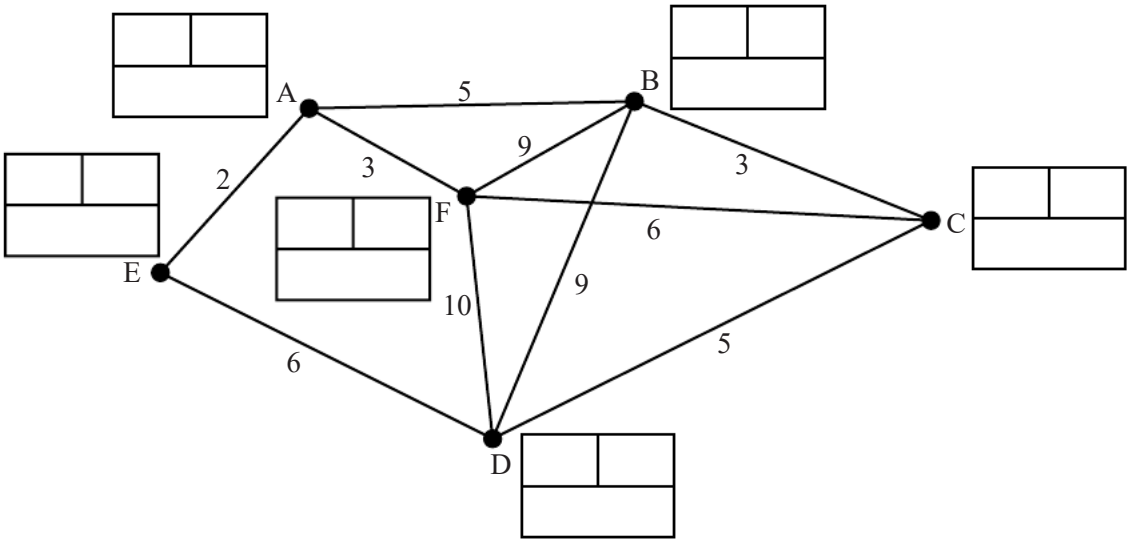


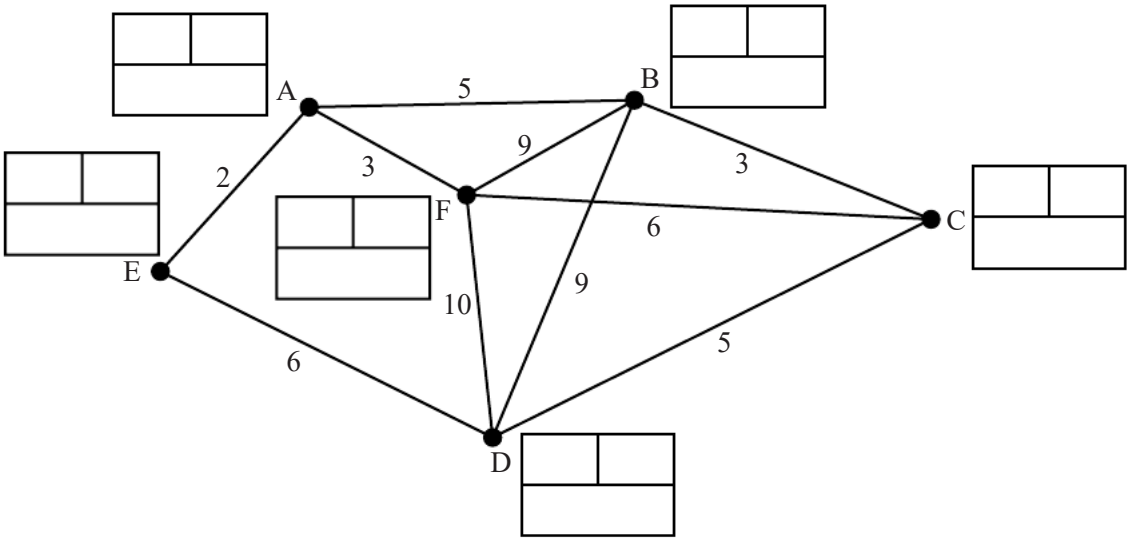


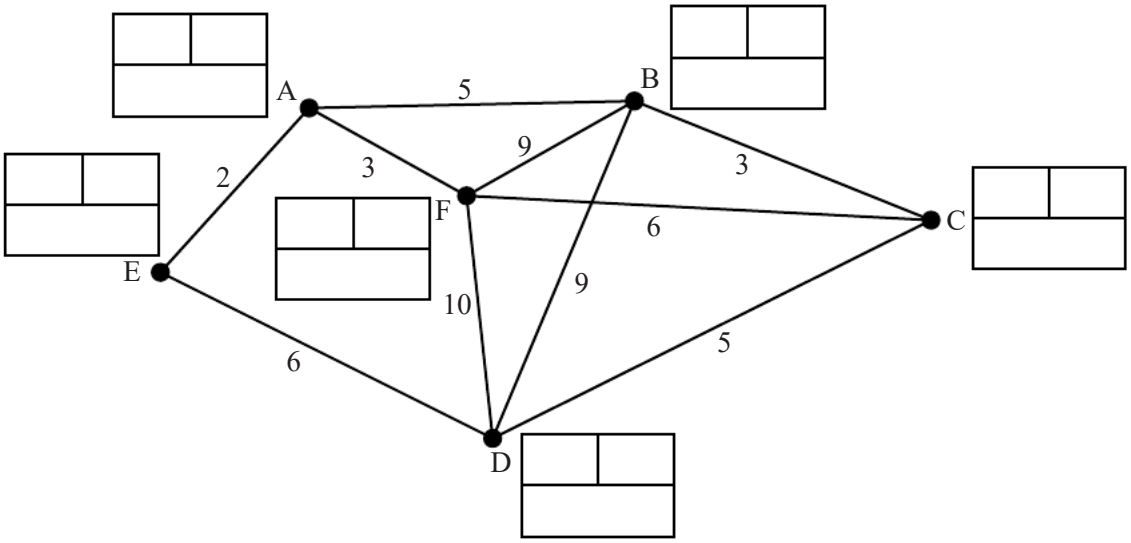


(answer space continued on next page)

4 (a)(i) **(continued)**







4 (a)(ii)

	A	B	C	D	E	F
A	–					
B		–				
C			–			
D				–		
E					–	
F						–

4 (a)(iii)

4 (a)(iv)

4 (b)(i)	
4 (b)(ii)	

OCR
Oxford Cambridge and RSA

GCE

Mathematics (MEI)

Unit **4772**: Decision Mathematics 2

Advanced GCE

Mark Scheme for June 2014

1. Annotations and abbreviations

Annotation in scoris	Meaning
BP	Blank Page – this annotation **must** be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
✓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

2. Subject-specific Marking Instructions for GCE Mathematics (MEI) Decision strand

a Annotations should be used whenever appropriate during your marking.

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

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

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

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

c The following types of marks are available.

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

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

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

E

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

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

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

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

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

f Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise. Candidates are expected to give numerical answers to an appropriate degree of accuracy, 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

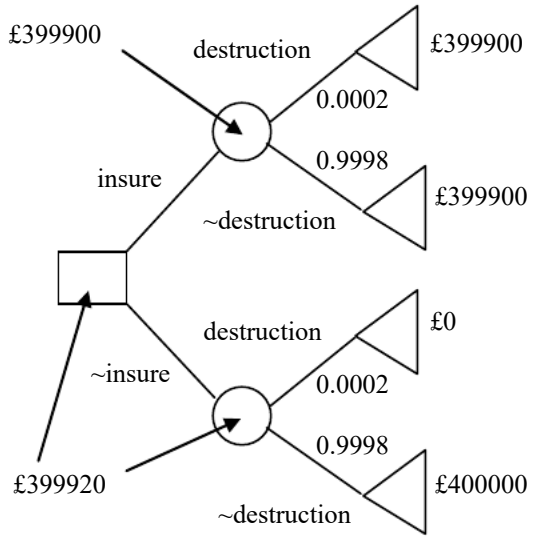
If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

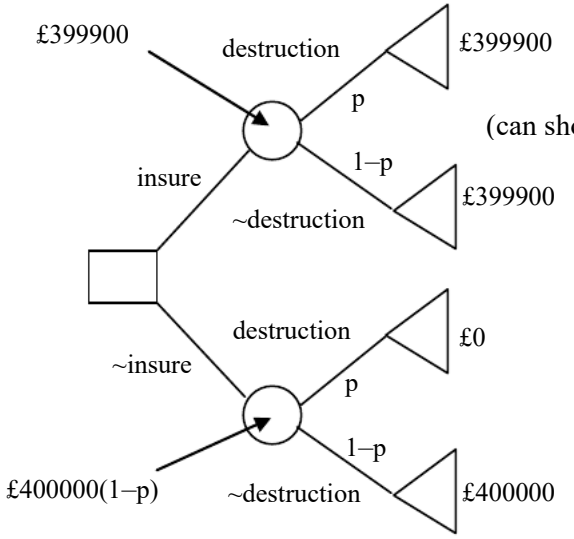
If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

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)			M1 A1 M1 A1 M1 A1	Decision node (with labels) insure chance nodes (with labels) (can show just one arc) ~insure chance node (with labels)
			EMV is £399920, by not insuring.	B1 B1 **[8]**	EMV course of action
1	(iii)		£80	B1 **[1]**	
1	(iv)		Insuring has a utility of $\sqrt{399900} = 632.3765$ Not insuring has a utility of $0.9998\times\sqrt{400000} = 632.329$ So utility is maximised by insuring.	M1 A1 B1 **[3]**	prob$\times\sqrt{\text{value}}$ not $\sqrt{\text{prob}\times\text{value}}$ both utilities (cao) www

Question			Answer	Marks	Guidance
1	(v)		 (can show 399900 with probability 1)	B1 **[1]**	*p* used on ~ insure branch
1	(vi)		The condition for insurance to be worthwhile is that 399900 > 400000(1−p) i.e. p > 0.00025.	M1 A1 **[2]**	cao
1	(vii)		The EMV analysis does not take adequate account of the loss caused by destruction. That is why the concept of utility is needed.	B1 **[1]**	

Question			Answer	Marks	Guidance
2	(a)	(i)	Either the ball hit the bat or it did not. If it hit the bat then the batsman is out caught. If it did not hit the bat then he is out LBW. In both cases he is out, and there is no other possibility.	M1 A1 A1 **[3]**	or equivalent
2	(a)	(ii)	$\sim lb \Rightarrow b$	B1 **[1]**	
2	(a)	(iii)	$\sim c \Rightarrow \sim b$	B1 **[1]**	
2	(a)	(iv)	$\sim o \Rightarrow (\sim lb \wedge \sim c) \Rightarrow (b \wedge \sim b)$	B1 **[1]**	reversing and negating cao
2	(a)	(v)	$\sim(b \wedge \sim b) \Rightarrow o$	M1 A1 **[2]**	

Question			Answer	Marks	Guidance
2	(b)	(i)	$d \Rightarrow (a \vee b \vee c)$, or equivalent	B1 **[1]**	
2	(b)	(ii)			

a	b	c	d		(d	⇒	(a∨b∨c))		∧		~	(b∨c)
0	0	0	0		0	1	0		1		1	0
0	0	0	1		1	0	0		0		1	0
0	0	1	0		0	1	1		0		0	1
0	0	1	1		1	1	1		0		0	1
0	1	0	0		0	1	1		0		0	1
0	1	0	1		1	1	1		0		0	1
0	1	1	0		0	1	1		0		0	1
0	1	1	1		1	1	1		0		0	1
1	0	0	0		0	1	1		1		1	0
1	0	0	1		1	1	1		1		1	0
1	0	1	0		0	1	1		0		0	1
1	0	1	1		1	1	1		0		0	1
1	1	0	0		0	1	1		0		0	1
1	1	0	1		1	1	1		0		0	1
1	1	1	0		0	1	1		0		0	1
1	1	1	1		1	1	1		0		0	1

Marks	Guidance
M1	16 rows covering all possibilities
A1	$d \Rightarrow (a \vee b \vee c)$
A1	$\sim(b \vee c)$
A1	overall conjunction √
[4]	

Question			Answer	Marks	Guidance
2	(b)	(iii)	Either A, or (A and D), or none of them	B1 B1 B1 **[3]**	 Disallowed by the stem, but allowed by the table!
3	(i)		Let a be the number of kg of A … Line 1 ⇔ max $(7–3)a+(5–2)b+(4–3)c$ ⇔ 4a+3b+c Line 2 ⇔ $10a + 5b + 12c \le 12000$ (availability of X) Line 3 ⇔ $5a + 5b + 7c \le 12000$ (availability of Y) Line 4 ⇔ $5a + 3b + 5c \le 9000$ (availability of Z)	B1 B1 B1 B1 B1 B1 **[6]**	variable defs. objective (7–3) ... identifying constraints LHS (used) ≤ + RHS (available)
3	(ii)				

P	a	b	c	s1	s2	s3	RHS
1	-4	-3	-1	0	0	0	0
0	10	5	12	1	0	0	12000
0	5	5	7	0	1	0	12000
0	5	3	5	0	0	1	9000
1	0	-1	3.8	0.4	0	0	4800
0	1	0.5	1.2	0.1	0	0	1200
0	0	2.5	1	-0.5	1	0	6000
0	0	0.5	-1	-0.5	0	1	3000

B1 Pivot

M1A1

or

1	2	0	6.2	0.6	0	0	7200	1	0	0	4.2	0.2	0.4	0	7200
0	2	1	2.4	0.2	0	0	2400	0	1	0	1	0.2	-0.2	0	0
0	-5	0	-5	-1	1	0	0	0	0	1	0.4	-0.2	0.4	0	2400
0	-1	0	-2.2	-0.6	0	1	1800	0	0	0	-1.2	-0.4	-0.2	1	1800

B1 Pivot √
M1
A1 cao

Make 2400 kg of B
at a profit of £7200 with 1.8kg of Z left

B1 must refer to kg
B1
[8]

Question			Answer	Marks	Guidance
3	(iii)		Either ... It means that the second constraint is coincidentally exactly satisfied at the solution. or ... It means that product A is in the solution, but at zero value. (Candidates may refer to degeneracy, which will earn the mark.)	B1 [1]	
3	(iv)		<table><tr><th>Q</th><th>P</th><th>a</th><th>b</th><th>c</th><th>s1</th><th>s2</th><th>s3</th><th>s4</th><th>f</th><th>RHS</th></tr><tr><td>1 0</td><td>0 1</td><td>1 -4</td><td>0 -3</td><td>0 -1</td><td>0 0</td><td>0 0</td><td>0 0</td><td>-1 0</td><td>0 0</td><td>500 0</td></tr><tr><td>0</td><td>0</td><td>10</td><td>5</td><td>12</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>12000</td></tr><tr><td>0</td><td>0</td><td>5</td><td>5</td><td>7</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>12000</td></tr><tr><td>0</td><td>0</td><td>5</td><td>3</td><td>5</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>9000</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-1</td><td>1</td><td>500</td></tr></table> Minimise Q until 0 (if feasible). Then drop Q and f and proceed to optimum. Allow up to 3 out of 5 for big M.	B1 B1 B1 B1 B1 [5]	new objective surplus+artificial new constraint

Question			Answer	Marks	Guidance
4	(a)	(i)	Dijkstra starting at A working values order of labelling labels 4 more starting points on 5, 4, 3, 2 vertices (or more likely and tediously 5 more, each on 6 vertices).	B1 B1 B1 B1 M1 A2 **[7]**	update at D working values order of labelling labels -1 each error
4	(a)	(ii)		B2 **[2]**	-1 each error

	A	B	C	D	E	F
A	–	5	8	8	2	3
B	5	–	3	8	7	8
C	8	3	–	5	10	6
D	8	8	5	–	6	10
	2	7	10	6	–	5
F	3	8	6	10	5	–

Question			Answer	Marks	Guidance
4	(a)	(iii)	Max of a row or a column Minimum of the maxima A, B, or A or B	M1 M1 A1 **[3]**	 dependent on both Ms
4	(a)	(iv)	From a point on AB the route to D is via A or B, and from part (ii) therefore exceeds 8.	B1 **[1]**	
4	(b)	(i)	A 2 E 6 D 5 C 3 B 9 F 3 A So F A E D C B with total length 19	M1A1 B1 **[3]**	
4	(b)	(ii)	B 3 C 5 D 6 E 2 A 3 F 9 B so F B C D E A – 19 C 3 B 5 A 2 E 6 D 10 F 6 C so F C B A E D – 22 D 5 C 3 B 5 A 2 E stuck E 2 A 3 F 6 C 3 B 9 D 6 E so D E A F C B – 20 F 3 A 2 E 6 D 5 C 3 B 8 F so F A E D C B – 19 So 19 is min length with either listing given.	B3 B1 **[4]**	-1 for each error, including failing to stop when starting from D

4772 Decision Mathematics 2

General Comments:

There are no general points.

Comments on Individual Questions:

Question No 1.

(i) This was done well.

(ii) Fewer than half of the candidates could correctly compute the EMV. Many were distracted by computing losses. Others were totally confused.

(iii) This was done well.

(iv) Only about half showed a utility × probability computation.

(v) This was done well.

(vi) Candidates scored well on this, although some were poor in handling the inequality. The phrasing of the question allowed them to get away with poor algebra.

(vii) Few candidates answered the question. Most made obvious statements which did not answer the question.

Question No 2.

(a)(i) This was difficult. The essence was that either the ball hit the bat or it did not (total probability). It was essential to recognise this explicitly. Successful candidates received reinforcement in (a)(v).

(a)(ii) About half of the candidates had the implication reversed.

(a)(iii) About half of the candidates had the implication reversed.

(a)(iv) About half of the candidates had the implication reversed.

(a)(v) Only a very few candidates could correctly negate both sides and reverse the implication to get the contrapositive.

(b)(i) There are several equivalent alternatives for the answer ... $d \Rightarrow (a \vee b \vee c)$ or $\sim(a \vee b \vee c) \Rightarrow \sim d$ or $(\sim a \wedge \sim b \wedge \sim c) \Rightarrow \sim d$ or $\sim(d \wedge \sim(a \vee b \vee c))$ or $\sim d \vee a \vee b \vee c$ ... but most candidates got none of these.

(b)(ii) To gain the method mark, the truth table needed 16 lines. Some candidates used complex unbracketed expressions, so that the column giving the overall truth value was not known, making “following” difficult.

(b)(iii) Most scored 2 of the 3 marks here.

Question No 3.

(i) The modal mark was 5. This was because hardly any candidates correctly identified the variables. For instance, a common offering was "Let *a* be the amount of *A* ...", or similar. That would allow *a* to be, for example, 1000kg. But in the algebra of number, and in the modelling which is given, letters represent numbers.
This point has been emphasised in examiner reports every year, but still it eludes candidates. Variable definitions MUST be in terms of "... number of ...", in this case "Let *a* be the number of kg of *A* ...". This is not being picky. Precise variable definition is absolutely crucial to correct modelling.
Some candidates tried to answer this in words ... possible, but in practice this did not lead to many marks.

(ii) The simplex was done well. However, the interpretation was often incomplete or had units missing, which were vital in this question.

(iii) Again, interpretations were often incomplete.

(iv) The question asked for incorporation into initial tableau, but candidates often lost marks by failing to do this.

Question No 4.

(a)(i) This was done well, although some candidates were upset that Floyd was not tested. Some were very critical, even though the specification is quite clear on requiring either Floyd or the repeated application of Dijkstra. Lack of appreciation of this led to inefficiency on a grand scale. Having found all shortest routes from A in the first application, A and its arcs can be deleted from subsequent networks. Similarly for B, etc, so that the work involved is halved. No candidate did this.

(a)(ii) This was done well.

(a)(iii) More than half of the candidates incorrectly computed the total of shortest distances from each vertex in turn, and then minimised that.

(a)(iv) This was, arguably, the hardest mark on paper. Only by considering distances to D could it be scored.

(b)(i) Many candidates failed to answer the question, for instance, failing to give the connections.

(b)(ii) This was badly done. Some candidates who were successful with (b)(i), did not seem to be able to do (b)(ii).

Unit level raw mark and UMS grade boundaries June 2014 series

AS GCE / Advanced GCE / AS GCE Double Award / Advanced GCE Double Award

GCE Mathematics (MEI)

		Max Mark	a	b	c	d	e	u
4751/01 (C1) MEI Introduction to Advanced Mathematics	Raw	72	61	56	51	46	42	0
	UMS	100	80	70	60	50	40	0
4752/01 (C2) MEI Concepts for Advanced Mathematics	Raw	72	57	51	45	39	33	0
	UMS	100	80	70	60	50	40	0
4753/01 (C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	58	52	47	42	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
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	68	61	54	47	41	0
	UMS	100	80	70	60	50	40	0
4755/01 (FP1) MEI Further Concepts for Advanced Mathematics	Raw	72	63	57	51	45	40	0
	UMS	100	80	70	60	50	40	0
4756/01 (FP2) MEI Further Methods for Advanced Mathematics	Raw	72	60	54	48	42	36	0
	UMS	100	80	70	60	50	40	0
4757/01 (FP3) MEI Further Applications of Advanced Mathematics	Raw	72	57	51	45	39	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
4758 (DE) MEI Differential Equations with Coursework	UMS	100	80	70	60	50	40	0
4761/01 (M1) MEI Mechanics 1	Raw	72	57	49	41	34	27	0
	UMS	100	80	70	60	50	40	0
4762/01 (M2) MEI Mechanics 2	Raw	72	57	49	41	34	27	0
	UMS	100	80	70	60	50	40	0
4763/01 (M3) MEI Mechanics 3	Raw	72	55	48	42	36	30	0
	UMS	100	80	70	60	50	40	0
4764/01 (M4) MEI Mechanics 4	Raw	72	48	41	34	28	22	0
	UMS	100	80	70	60	50	40	0
4766/01 (S1) MEI Statistics 1	Raw	72	61	53	46	39	32	0
	UMS	100	80	70	60	50	40	0
4767/01 (S2) MEI Statistics 2	Raw	72	60	53	46	40	34	0
	UMS	100	80	70	60	50	40	0
4768/01 (S3) MEI Statistics 3	Raw	72	61	54	47	41	35	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	51	46	41	36	31	0
	UMS	100	80	70	60	50	40	0
4772/01 (D2) MEI Decision Mathematics 2	Raw	72	46	41	36	31	26	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	54	48	43	38	32	0
4776/02 (NM) MEI Numerical Methods with Coursework: Coursework	Raw	18	14	12	10	8	7	0
4776/82 (NM) MEI Numerical Methods with Coursework: Carried Forward Coursework Mark	Raw	18	14	12	10	8	7	0
4776 (NM) MEI Numerical Methods with Coursework	UMS	100	80	70	60	50	40	0
4777/01 (NC) MEI Numerical Computation	Raw	72	55	47	39	32	25	0
	UMS	100	80	70	60	50	40	0
4798/01 (FPT) Further Pure Mathematics with Technology	Raw	72	57	49	41	33	26	0
	UMS	100	80	70	60	50	40	0

GCE Statistics (MEI)

		Max Mark	a	b	c	d	e	u
G241/01 (Z1) Statistics 1	Raw	72	61	53	46	39	32	0
	UMS	100	80	70	60	50	40	0
G242/01 (Z2) Statistics 2	Raw	72	55	48	41	34	27	0
	UMS	100	80	70	60	50	40	0
G243/01 (Z3) Statistics 3	Raw	72	56	48	41	34	27	0
	UMS	100	80	70	60	50	40	0