OCR
Oxford Cambridge and RSA

Wednesday 3 June 2015 – Morning

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 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.

1 A furniture manufacturer is planning a production run. He will be making wardrobes, drawer units and desks. All can be manufactured from the same wood.

He has available $200\,m^2$ of wood for the production run. Allowing for wastage, a wardrobe requires $5\,m^2$, a drawer unit requires $3\,m^2$, and a desk requires $2\,m^2$.

He has 200 hours available for the production run. A wardrobe requires 4.5 hours, a drawer unit requires 5.2 hours, and a desk requires 3.8 hours.

The completed furniture will have to be stored at the factory for a short while before being shipped. The factory has $50\,m^3$ of storage space available. A wardrobe needs $1\,m^3$, a drawer unit needs $0.75\,m^3$, and a desk needs $0.5\,m^3$.

The manufacturer needs to know what he should produce to maximise his income. He sells the wardrobes at £80 each, the drawer units at £65 each and the desks at £50 each.

(i) Formulate the manufacturer's problem as an LP. **[6]**

(ii) Use the Simplex algorithm to solve the LP problem. **[6[**

(iii) Interpret the results. **[3]**

(iv) An extra $25\,m^2$ of wood is found and is to be used. The new optimal solution is to make 44 wardrobes, no drawer units and no desks. However, this leaves some of each resource (wood, hours and space) left over. Explain how this can be possible. **[1]**

2 **(i)** Given that x and y are propositions, draw a 4-line truth table for $x \Rightarrow y$, allowing x and y to take all combinations of truth values.

If x is false and $x \Rightarrow y$ is true, what can be deduced about the truth value of y? **[2]**

A story has it that, in a lecture on logic, the philosopher Bertrand Russell (1872–1970) mentioned that a false proposition implies any proposition.

A student challenged this, saying "In that case, given that 1 = 0, prove that you are the Pope."

Russell immediately replied, "Add 1 to both sides of the equation: then we have 2 = 1. The set containing just me and the Pope has 2 members. But 2 = 1, so the set has only 1 member; therefore, I am the Pope."

Russell's string of statements is an example of a deductive sequence. Let a represent "1 = 0", b represent "2 = 1", c represent "Russell and the Pope are 2" and d represent "Russell and the Pope are 1". Then Russell's deductive sequence can be written as $(a \wedge (a \Rightarrow b) \wedge c) \Rightarrow d$.

(ii) Assuming that a is false, b is false, $a \Rightarrow b$ is true, c is true, and that d can take either truth value, draw a 2-line truth table for $(a \wedge (a \Rightarrow b) \wedge c) \Rightarrow d$. **[2]**

(iii) What does the table tell you about d with respect to the false proposition a? **[2]**

(iv) Explain why Russell introduced propositions b and c into his argument. **[1]**

(v) Russell could correctly have started a deductive sequence:

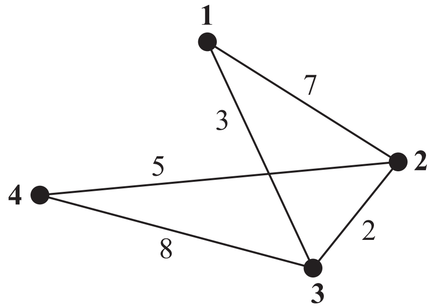
$$a \wedge [a \Rightarrow ((0.5 = -0.5) \Rightarrow (0.25 = 0.25))].$$

Had he have done so could he correctly have continued it to end at d?

Justify your answer. **[2]**

(vi) Draw a combinatorial circuit to represent $(a \wedge (a \Rightarrow b) \wedge c) \Rightarrow d$. **[7]**

3 Floyd's algorithm is applied to the incomplete network on 4 nodes drawn below. The weights on the arcs represent journey times.



The final matrices are shown below.

final time matrix

	1	**2**	**3**	**4**
1	6	5	3	10
2	5	4	2	5
3	3	2	4	7
4	10	5	7	10

final route matrix

	1	**2**	**3**	**4**
1	3	3	3	3
2	3	3	3	4
3	1	2	2	2
4	2	2	2	2

(i) Draw the complete network of shortest times. **[2]**

(ii) Explain how to use the final route matrix to find the quickest route from node **4** to node **1** in the original incomplete network. Give this quickest route. **[3]**

A new node, node **5**, is added to the original incomplete network. The new journey times are shown in the table.

	1	**2**	**3**	**4**
5	4	–	–	2

(iii) Draw the complete 5-node network of shortest times. (You are not required to use an algorithm to find the shortest times.) **[3]**

(iv) Write down the final time matrix and the final route matrix for the complete 5-node network. (You do not need to apply Floyd's algorithm.) **[3]**

(v) (*A*) Apply the nearest neighbour algorithm to the complete 5-node network of shortest times, starting at node **1**. Give the time for the cycle you produce. **[2]**

(*B*) Starting at node **3**, a possible cycle in the complete 5-node network of shortest times is **3 2 1 5 4 3**. Give the actual cycle to which this corresponds in the incomplete 5-node network of journey times. **[1]**

(vi) By deleting node **5** and its arcs from the complete 5-node network of shortest times, and then using Kruskal's algorithm, produce a lower bound for the solution to the associated practical travelling salesperson problem. Show clearly your use of Kruskal's algorithm. **[3]**

(vii) In the incomplete 5-node network of journey times, find a quickest route starting at node **5** and using each of the 7 arcs at least once. Give the time of your route. **[3]**

4 Helen has a meeting to go to in London. She has to travel from her home in G on the south coast to KC in London. She can drive from G to the west to A to catch a train, or she can drive to the east to W to catch a train on a different line. From both A and W she can travel to mainline terminuses V or LB in London. She will then travel by tube either from V to KC, or from LB to KC.

The times for the various steps of her journey are shown in the tables. Both train services and tube services are subject to occasional delays, and these are modelled in the tables.

Driving times	to A	to W
From G	20 min	15 min

Train journey	To V			To LB		
	normal time	probability of delay	delay	normal time	probability of delay	delay
From A	1 hr 40 min	0.05	10 min	1 hr 45 min	0.05	10 min
From W	1 hr 30 min	0.10	20 min	1 hr 35 min	0.10	20 min

Tube journey	To KC		
	normal time	probability of delay	delay
From V	7 min	0.20	2 min
From LB	9 min	0.10	2 min

Helen wants to choose the route which will give the shortest expected journey time.

(i) Draw a decision tree to model Helen's decisions and the possible outcomes. **[8]**

(ii) Calculate Helen's shortest expected journey time and give the route which corresponds to that shortest expected journey time. **[8]**

As she gets into her car, Helen hears a travel bulletin on the radio warning of a broken escalator at V. This means that routes through V will take Helen 10 minutes longer.

(iii) Find the value of the radio information, explaining your calculation. **[3]**

(iv) Why might the shortest expected journey time not be the best criterion for choosing a route for Helen? **[1]**

END OF QUESTION PAPER

BLANK PAGE

BLANK PAGE

OCR
Oxford Cambridge and RSA

Wednesday 3 June 2015 – Morning

A2 GCE MATHEMATICS (MEI)

4772/01 Decision Mathematics 2

PRINTED ANSWER BOOK

Candidates answer on this Printed Answer Book.

OCR supplied materials:
- Question Paper 4772/01 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

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 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 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.

1 (i)	
1 (ii)	
	(answer space continued on next page)

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

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

2 (vi)	

3 (i)	
3 (ii)	

3 (iii)

3 (iv)

final time matrix

	1	2	3	4	5
1					
2					
3					
4					
5					

final route matrix

	1	2	3	4	5
1					
2					
3					
4					
5					

3 (v) (*A*)	
3 (v) (*B*)	
3 (vi)	**(answer space continued on next page)**

3 (vi)	**(continued)**
3 (vii)	

4(i)&(ii)	
	(answer space continued on next page)

4(i)&(ii)	**(continued)**

4 (iii)	
4 (iv)	

These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning of annotation
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.

Annotation in scoris	**Meaning**
✓and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
Highlighting	
Other abbreviations in mark scheme	**Meaning**
E1	Mark for explaining
U1	Mark for correct units
G1	Mark for a correct feature on a graph
M1 dep*	Method mark dependent on a previous mark, indicated by *
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working

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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>(i)</td><td></td><td>Let w be the number of wardrobes made.
Let u be the number of drawer units made.
Let d be the number of desks made.

Max $80w+65u+50d$
st $5w+3u+2d < 200$
$4.5w+5.2u+3.8d < 200$
$w+0.75u+0.5d < 50$</td><td>B1
B1

B1
B1
B1
B1</td><td>definition
“number of”

SC …
-2 for consistent “>”</td></tr>
<tr><td>1</td><td>(ii)</td><td></td><td>
<table>
<tr><th>M</th><th>w</th><th>u</th><th>d</th><th>s1</th><th>s2</th><th>s3</th><th>RHS</th></tr>
<tr><td>1</td><td>-80</td><td>-65</td><td>-50</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>5</td><td>3</td><td>2</td><td>1</td><td>0</td><td>0</td><td>200</td></tr>
<tr><td>0</td><td>4.5</td><td>5.2</td><td>3.8</td><td>0</td><td>1</td><td>0</td><td>200</td></tr>
<tr><td>0</td><td>1</td><td>0.75</td><td>0.5</td><td>0</td><td>0</td><td>1</td><td>50</td></tr>
<tr><td>1</td><td>0</td><td>-17</td><td>-18</td><td>16</td><td>0</td><td>0</td><td>3200</td></tr>
<tr><td>0</td><td>1</td><td>0.6</td><td>0.4</td><td>0.2</td><td>0</td><td>0</td><td>40</td></tr>
<tr><td>0</td><td>0</td><td>2.5</td><td>2</td><td>-0.9</td><td>1</td><td>0</td><td>20</td></tr>
<tr><td>0</td><td>0</td><td>0.15</td><td>0.1</td><td>-0.2</td><td>0</td><td>1</td><td>10</td></tr>
<tr><td>1</td><td>0</td><td>5.5</td><td>0</td><td>7.9</td><td>9</td><td>0</td><td>3380</td></tr>
<tr><td>0</td><td>1</td><td>0.1</td><td>0</td><td>0.38</td><td>-0.2</td><td>0</td><td>36</td></tr>
<tr><td>0</td><td>0</td><td>1.25</td><td>1</td><td>-0.45</td><td>0.5</td><td>0</td><td>10</td></tr>
<tr><td>0</td><td>0</td><td>0.025</td><td>0</td><td>-0.155</td><td>-0.05</td><td>1</td><td>9</td></tr>
</table>
w=36, u=0, d=10 and M=3380 with s1=s2=0 and s3=9 (not needed)</td><td>M1

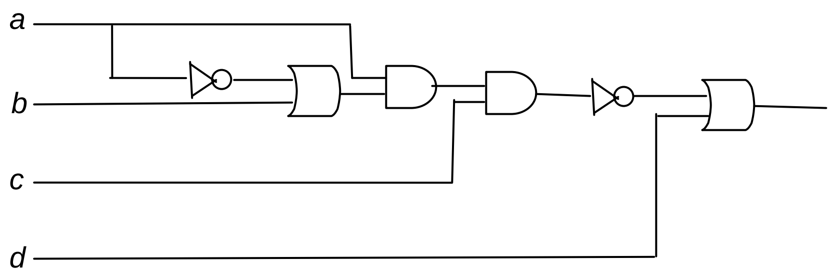
A1√

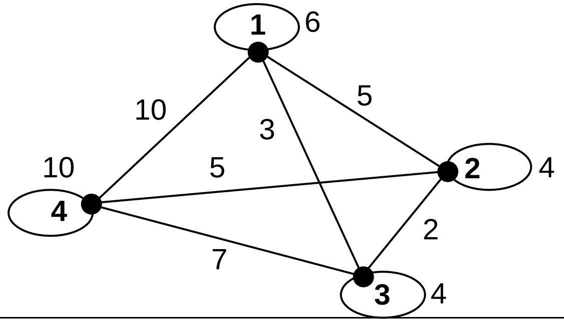
M1
A1√

M1
A1√</td><td>initial tableau
obj + 3 constraints
initial tableau OK

pivot

pivot</td></tr>
<tr><td>1</td><td>(iii)</td><td></td><td>Make 36 wardrobes and 10 desks.
Income = £3380
$9m^3$ of storage space spare</td><td>B1√
B1√
B1√</td><td></td></tr>
<tr><td>1</td><td>(iv)</td><td></td><td>An integer solution is required, and that may mean that no resource is exhausted.</td><td>B1</td><td></td></tr>
</table>

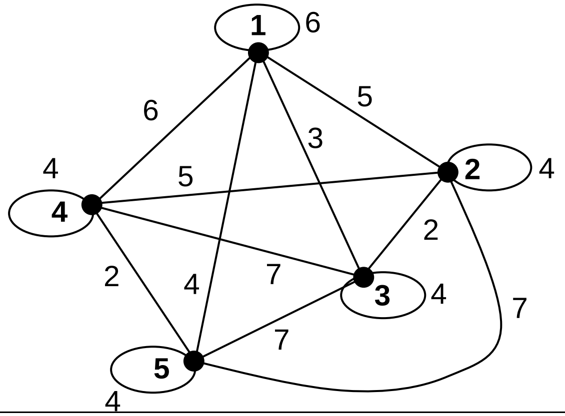
Question			Answer	Marks	Guidance
2	(i)		<table><tr><td>*x*</td><td>*y*</td><td>$x \Rightarrow y$</td></tr><tr><td>1</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>0</td><td>0</td><td>1</td></tr></table>	B1	cao
			y can either be true or false.	B1	
2	(ii)		<table><tr><td>*a*</td><td>*b*</td><td>*c*</td><td>$a \Rightarrow b$</td><td>$a \wedge (a \Rightarrow b)$</td><td>$a \wedge (a \Rightarrow b) \wedge c$</td><td>*d*</td><td>$(a \wedge (a \Rightarrow b) \wedge c) \Rightarrow d$</td></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr></table>	B1 B1	SC … -1 for shortened form with order not explicit
2	(iii)		That one can build a (correct) deductive sequence from *a* to *d*, whether *d* is true or false.	B1 B1	deduction *d* true or false
2	(iv)		So that he could establish a (correct) deductive sequence from "1=0" to "Russell is the Pope".	B1	
2	(v)		No, because from a true statement only truth can correctly be deduced, and Russell was not the Pope.	M1 A1	true to false needed so "no"
2	(vi)			B1 M1 A1 M1 A1 M1 A1	using *abcd* as inputs implying *b* implying *d* using an "and" both correct

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3</td><td>(i)</td><td></td><td>
</td><td>B1

B1</td><td>complete network, including loops

all 10 times correct</td></tr>
<tr><td>3</td><td>(ii)</td><td></td><td>Look in row 4, column 1 to find first vertex en route ... 2
Now look in row 2 column 1 ... 3
Now row 3 column 1 ... 1
So route is 4 → 2 → 3 → 1</td><td>M1

A1
B1</td><td>explanation of one correct step

SC …
-1 for reverse</td></tr>
<tr><td>3</td><td>(iii)</td><td></td><td>
</td><td>M1
A1
A1</td><td>complete inc. loops
5-5, 5-2 and 5-3
1-4 and 4-4

SC … -1 only here if no loops if already penalised in (i)</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3</td><td>(iv)</td><td></td><td>
Time Matrix
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><td>1</td><td>6</td><td>5</td><td>3</td><td>6</td><td>4</td></tr>
<tr><td>2</td><td>5</td><td>4</td><td>2</td><td>5</td><td>7</td></tr>
<tr><td>3</td><td>3</td><td>2</td><td>4</td><td>7</td><td>7</td></tr>
<tr><td>4</td><td>6</td><td>5</td><td>7</td><td>4</td><td>2</td></tr>
<tr><td>5</td><td>4</td><td>7</td><td>7</td><td>2</td><td>4</td></tr>
</table>
Route Matrix
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><td>1</td><td>3</td><td>3</td><td>3</td><td>5</td><td>5</td></tr>
<tr><td>2</td><td>3</td><td>3</td><td>3</td><td>4</td><td>4</td></tr>
<tr><td>3</td><td>1</td><td>2</td><td>2</td><td>2</td><td>1</td></tr>
<tr><td>4</td><td>5</td><td>2</td><td>2</td><td>5</td><td>5</td></tr>
<tr><td>5</td><td>1</td><td>4</td><td>1</td><td>4</td><td>4</td></tr>
</table>
</td><td>B1

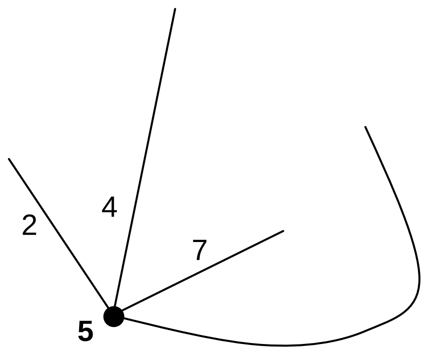
B1

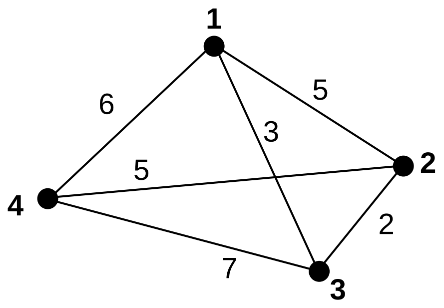
B1√</td><td>cao for times

3 correct changes to old routes
all new routes correct</td></tr>
<tr><td>3</td><td>(v)</td><td>(A)

(B)</td><td>Route (fastest times) = 1 3 2 4 5 1
Time = 3+2+5+2+4 = 16

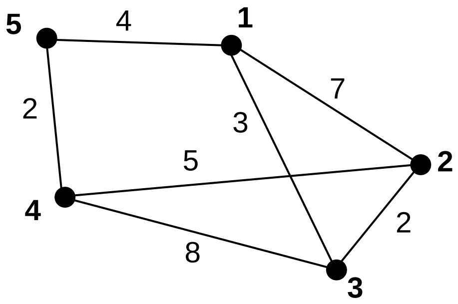
3 2 1 5 4 3 has actual route 3 2 (3) 1 5 4 (2) 3</td><td>B1
B1

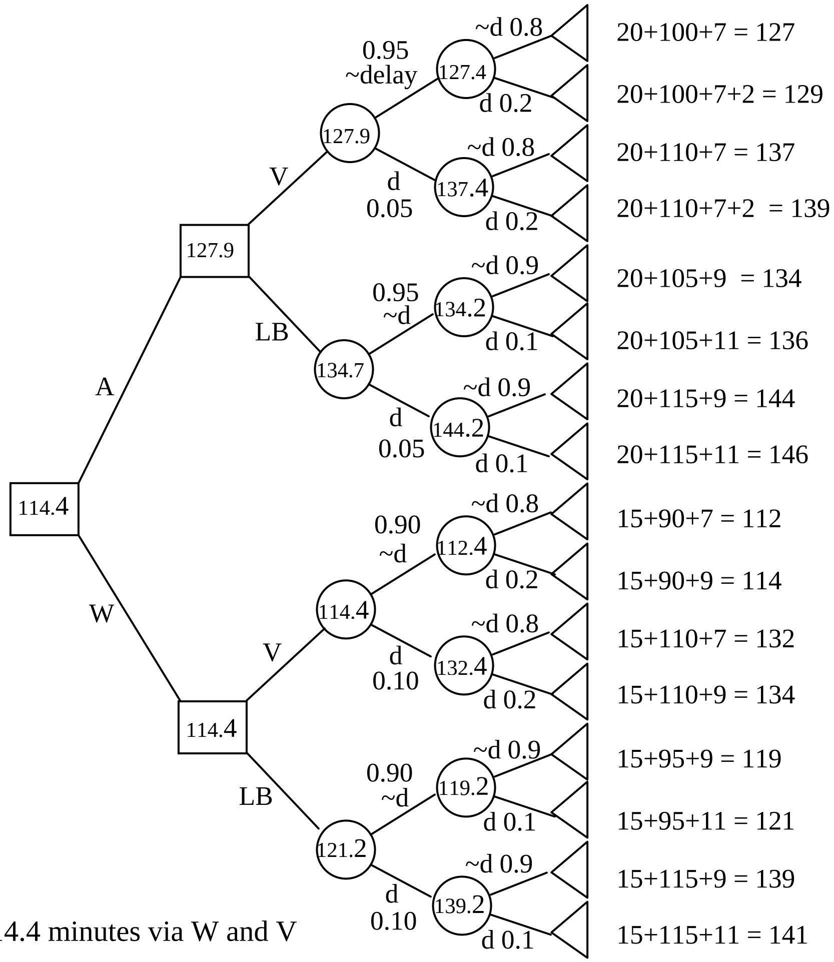
B1</td><td></td></tr>
<tr><td>3</td><td>(vi)</td><td></td><td>




Kruskal ... 3-2 then 3-1 then 2-4 ... length = 10

So lower bound = 10 + 2 + 4 = 16</td><td>M1
A1
B1√</td><td>Kruskal</td></tr>
</table>

Question			Answer	Marks	Guidance
3	(vii)				
			costs of pairings ... (**1-2**, **3-4**) = 5+7 = 12 (**1-3**, **2-4**) = 3+5 = 8 (**1-4**, **2-3**) = 6+2 = 8	B1	correct costs
			So quickest time is 31+8 = 39.	B1	39
			There are several routes, e.g. **5 1 3 1 2 4 2 3 4 5**	B1	**1-3** repeated (or **1-4**) **2-4** repeated (or **3-2**)

Question			Answer	Marks	Guidance
4	(i)(ii)		 114.4 minutes via W and V	M1 A1 M1 A1 M1 A1 M1 A1 M1 A1 M1 A1 M1 A1 M1 A1	A v W first drawn correctly V v LB second drawn correctly train delay v ~ delay third drawn correctly tube delay v ~ delay third drawn correctly 16 end values cao 8 2nd level chance computations cao 4 1st level chance computations cao 3 correct decision values √

Question			Answer	Marks	Guidance
4	(iii)		3.2 mins (Expected time via W and V + 10 – Expected time via W and LB)	M1 M1 A1√	(114.4+10) –121.2 3.2
4	(iv)		The timetable ... when a train leaves and when it arrives … or cost	B1	

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

OCR Customer Contact Centre

Education and Learning
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

OCR
Oxford Cambridge and RSA

GCE Mathematics (MEI)											
				Max Mark	a	b	c	d	e	u
4751	01	C1 – MEI Introduction to advanced mathematics (AS)	Raw	72	63	58	53	48	43	0
			UMS	100	80	70	60	50	40	0
4752	01	C2 – MEI Concepts for advanced mathematics (AS)	Raw	72	56	50	44	39	34	0
			UMS	100	80	70	60	50	40	0
4753	01	(C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	56	51	46	41	36	0
4753	02	(C3) MEI Methods for Advanced Mathematics with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4753	82	(C3) MEI Methods for Advanced Mathematics with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
			UMS	100	80	70	60	50	40	0
4754	01	C4 – MEI Applications of advanced mathematics (A2)	Raw	90	74	67	60	54	48	0
			UMS	100	80	70	60	50	40	0
4755	01	FP1 – MEI Further concepts for advanced mathematics (AS)	Raw	72	62	57	53	49	45	0
			UMS	100	80	70	60	50	40	0
4756	01	FP2 – MEI Further methods for advanced mathematics (A2)	Raw	72	65	58	52	46	40	0
			UMS	100	80	70	60	50	40	0
4757	01	FP3 – MEI Further applications of advanced mathematics (A2)	Raw	72	59	52	46	40	34	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	38	0
4758	02	(DE) MEI Differential Equations with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4758	82	(DE) MEI Differential Equations with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
			UMS	100	80	70	60	50	40	0
4761	01	M1 – MEI Mechanics 1 (AS)	Raw	72	62	54	46	39	32	0
			UMS	100	80	70	60	50	40	0
4762	01	M2 – MEI Mechanics 2 (A2)	Raw	72	54	47	40	33	27	0
			UMS	100	80	70	60	50	40	0
4763	01	M3 – MEI Mechanics 3 (A2)	Raw	72	64	56	48	41	34	0
			UMS	100	80	70	60	50	40	0
4764	01	M4 – MEI Mechanics 4 (A2)	Raw	72	53	45	38	31	24	0
			UMS	100	80	70	60	50	40	0
4766	01	S1 – MEI Statistics 1 (AS)	Raw	72	61	54	47	41	35	0
			UMS	100	80	70	60	50	40	0
4767	01	S2 – MEI Statistics 2 (A2)	Raw	72	65	60	55	50	46	0
			UMS	100	80	70	60	50	40	0
4768	01	S3 – MEI Statistics 3 (A2)	Raw	72	64	58	52	47	42	0
			UMS	100	80	70	60	50	40	0
4769	01	S4 – MEI Statistics 4 (A2)	Raw	72	56	49	42	35	28	0
			UMS	100	80	70	60	50	40	0
4771	01	D1 – MEI Decision mathematics 1 (AS)	Raw	72	56	51	46	41	37	0
			UMS	100	80	70	60	50	40	0
4772	01	D2 – MEI Decision mathematics 2 (A2)	Raw	72	54	49	44	39	34	0
			UMS	100	80	70	60	50	40	0
4773	01	DC – MEI Decision mathematics computation (A2)	Raw	72	46	40	34	29	24	0
			UMS	100	80	70	60	50	40	0
4776	01	(NM) MEI Numerical Methods with Coursework: Written Paper	Raw	72	56	50	45	40	34	0
4776	02	(NM) MEI Numerical Methods with Coursework: Coursework	Raw	18	14	12	10	8	7	0
4776	82	(NM) MEI Numerical Methods with Coursework: Carried Forward Coursework Mark	Raw	18	14	12	10	8	7	0
			UMS	100	80	70	60	50	40	0
4777	01	NC – MEI Numerical computation (A2)	Raw	72	55	47	39	32	25	0
			UMS	100	80	70	60	50	40	0
4798	01	FPT - Further pure mathematics with technology (A2)	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 Statistics 1 MEI (Z1)	Raw	72	61	54	47	41	35	0
		UMS	100	80	70	60	50	40	0
G242	01 Statistics 2 MEI (Z2)	Raw	72	55	48	41	34	27	0
		UMS	100	80	70	60	50	40	0
G243	01 Statistics 3 MEI (Z3)	Raw	72	56	48	41	34	27	0
		UMS	100	80	70	60	50	40	0

GCE Quantitative Methods (MEI)

			Max Mark	a	b	c	d	e	u
G244	01 Introduction to Quantitative Methods MEI	Raw	72	58	50	43	36	28	0
G244	02 Introduction to Quantitative Methods MEI	Raw	18	14	12	10	8	7	0
		UMS	100	80	70	60	50	40	0
G245	01 Statistics 1 MEI	Raw	72	61	54	47	41	35	0
		UMS	100	80	70	60	50	40	0
G246	01 Decision 1 MEI	Raw	72	56	51	46	41	37	0
		UMS	100	80	70	60	50	40	0