



GCE

Mathematics

Advanced GCE

Unit **4737**: Decision Mathematics 2

Mark Scheme for January 2013

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, 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 2013

4737

Mark Scheme

January 2013

Annotations and abbreviations

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

Other abbreviations in mark scheme	Meaning
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

4737

Mark Scheme

January 2013

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

4737

Mark Scheme

January 2013

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

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.

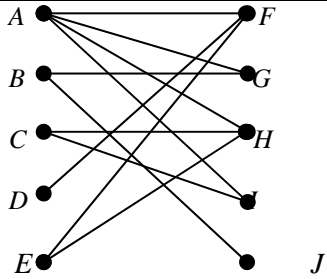
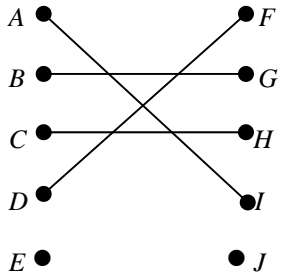
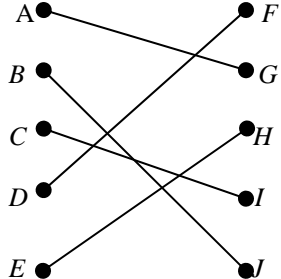
- h. For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for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

4737

Mark Scheme

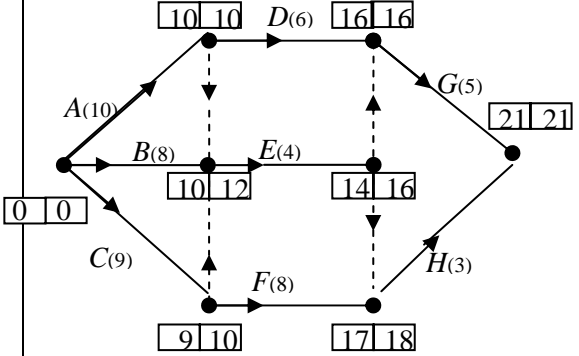
January 2013

Question		Answer	Marks	Guidance
1	(i)		B1 [1]	Bipartite graph correct (ignore any extra thickening of lines, labels attached for alternating paths, or an additional arc to X for alternating path)
1	(ii)	<p>$D = F - A = I$</p> 	B1 B1 [2]	A valid alternating path from D, written down in some form, not just read off from labels on graph. This matching drawn (cao)
1	(iii)	<p>$E = H - C = I - A = G - B = J$</p> 	B1 B1 [2]	This alternating path, written down in some form, not just read off from labels on graph. Allow reversed. This matching drawn (cao)
1	(iv)	<p>J can only pair with B and D must pair with F Hence G must pair with A, H must pair with E and C with I</p>	M1 A1 [2]	J must pair with B , D must pair with F Explaining why $A = G$, $C = I$ and $E = H$

4737

Mark Scheme

January 2013

Question	Answer	Marks	Guidance																											
2 (i)	<table border="1" data-bbox="427 240 954 592"> <thead> <tr> <th>Activity</th> <th>Duration</th> <th>Immediate predecessors</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>10</td> <td>-</td> </tr> <tr> <td>B</td> <td>8</td> <td>-</td> </tr> <tr> <td>C</td> <td>9</td> <td>-</td> </tr> <tr> <td>D</td> <td>6</td> <td>A</td> </tr> <tr> <td>E</td> <td>4</td> <td>A, B, C</td> </tr> <tr> <td>F</td> <td>8</td> <td>C</td> </tr> <tr> <td>G</td> <td>5</td> <td>D, E</td> </tr> <tr> <td>H</td> <td>3</td> <td>E, F</td> </tr> </tbody> </table>	Activity	Duration	Immediate predecessors	A	10	-	B	8	-	C	9	-	D	6	A	E	4	A, B, C	F	8	C	G	5	D, E	H	3	E, F	<p>B1</p> <p>B1</p> <p>[2]</p>	<p>Immediate predecessors correct for A to F (blank implies 'none')</p> <p>Immediate predecessors correct for G and H</p>
Activity	Duration	Immediate predecessors																												
A	10	-																												
B	8	-																												
C	9	-																												
D	6	A																												
E	4	A, B, C																												
F	8	C																												
G	5	D, E																												
H	3	E, F																												
2 (ii)	 <p data-bbox="421 1043 837 1075">Min completion time = 21 minutes</p> <p data-bbox="421 1114 734 1145">Critical activities: A, D, G</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>B1</p> <p>[5]</p>	<p>Forward pass with at most one independent error</p> <p>Backward pass with at most one independent error</p> <p>Both passes correct (cao)</p> <p>21 mins (cao) <u>with units</u></p> <p>A, D, G (cao)</p>																											

4737

Mark Scheme

January 2013

Question		Answer	Marks	Guidance
2	(iii)	<i>B and E</i>	M1 A1 [2]	Either correct and no critical activities listed Both correct and no incorrect activities (cao)
2	(iv)	It would increase by 2 mins <i>D or G</i>	B1 B1 [2]	Minimum completion time increases by 2, or time = 23 [(their) 21 + 2] Either (or both) of the critical activities (cao)
2	(v)	1 minute delay	B1 [1]	1 or time is now 22 [(their) 21 + 1]

4737

Mark Scheme

January 2013

Question	Answer	Marks	Guidance																																																
3 (i)	<table border="1" data-bbox="421 252 817 432"> <tr> <td></td> <td><i>N</i></td> <td><i>P</i></td> <td><i>R</i></td> <td><i>T</i></td> </tr> <tr> <td><i>J</i></td> <td>3</td> <td>2</td> <td>2</td> <td>2</td> </tr> <tr> <td><i>K</i></td> <td>2</td> <td>6</td> <td>5</td> <td>3</td> </tr> <tr> <td><i>L</i></td> <td>5</td> <td>9</td> <td>10</td> <td>6</td> </tr> <tr> <td><i>M</i></td> <td>2</td> <td>7</td> <td>6</td> <td>6</td> </tr> </table> <p data-bbox="421 483 1019 547">She needs to convert a maximising problem into a minimising problem</p>		<i>N</i>	<i>P</i>	<i>R</i>	<i>T</i>	<i>J</i>	3	2	2	2	<i>K</i>	2	6	5	3	<i>L</i>	5	9	10	6	<i>M</i>	2	7	6	6	<p data-bbox="1086 316 1131 339">B1</p> <p data-bbox="1086 483 1131 507">B1</p> <p data-bbox="1086 547 1131 579">[2]</p>	<p data-bbox="1176 316 1888 339">This matrix, with or without row and column headings (cao)</p> <p data-bbox="1176 483 1982 547">Hungarian algorithm finds allocation with minimum total Maximising correct guesses is same as minimising incorrect guesses</p>																							
	<i>N</i>	<i>P</i>	<i>R</i>	<i>T</i>																																															
<i>J</i>	3	2	2	2																																															
<i>K</i>	2	6	5	3																																															
<i>L</i>	5	9	10	6																																															
<i>M</i>	2	7	6	6																																															
3 (ii)	<p data-bbox="421 595 593 619">Reduce rows</p> <table border="1" data-bbox="472 619 788 754"> <tr><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>4</td><td>3</td><td>1</td></tr> <tr><td>0</td><td>4</td><td>5</td><td>1</td></tr> <tr><td>0</td><td>5</td><td>4</td><td>4</td></tr> </table> <p data-bbox="421 762 768 786">Columns are already reduced</p> <p data-bbox="421 930 667 954">Cross through zeros</p> <table border="1" data-bbox="472 962 788 1098"> <tr><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>4</td><td>3</td><td>1</td></tr> <tr><td>0</td><td>4</td><td>5</td><td>1</td></tr> <tr><td>0</td><td>5</td><td>4</td><td>4</td></tr> </table> <p data-bbox="421 1137 600 1161">Augment by 1</p> <table border="1" data-bbox="472 1169 788 1305"> <tr><td>2</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>3</td><td>2</td><td>0</td></tr> <tr><td>0</td><td>3</td><td>4</td><td>0</td></tr> <tr><td>0</td><td>4</td><td>3</td><td>3</td></tr> </table>	1	0	0	0	0	4	3	1	0	4	5	1	0	5	4	4	1	0	0	0	0	4	3	1	0	4	5	1	0	5	4	4	2	0	0	0	0	3	2	0	0	3	4	0	0	4	3	3	<p data-bbox="1086 627 1131 651">M1</p> <p data-bbox="1086 691 1131 715">A1</p> <p data-bbox="1086 970 1131 994">M1</p> <p data-bbox="1086 1034 1131 1058">A1</p>	<p data-bbox="1176 627 1915 651">Reducing rows or columns (for their matrix or for the original)</p> <p data-bbox="1176 691 1881 754">Reducing rows and columns correctly (no arithmetic errors) Condone columns reduced first followed by rows</p> <p data-bbox="1176 834 2027 898">If original (speculations matrix) is used no augmenting is possible so no further M or A marks.</p> <p data-bbox="1176 970 2004 1034">Crossing through zeros using min no of lines and augmenting by min uncovered value (method correct, including entries crossed out twice).</p> <p data-bbox="1176 1034 1556 1058">Correct augmented matrix (cao)</p>
1	0	0	0																																																
0	4	3	1																																																
0	4	5	1																																																
0	5	4	4																																																
1	0	0	0																																																
0	4	3	1																																																
0	4	5	1																																																
0	5	4	4																																																
2	0	0	0																																																
0	3	2	0																																																
0	3	4	0																																																
0	4	3	3																																																

4737

Mark Scheme

January 2013

Question	Answer	Marks	Guidance																																
<p>3 (ii)</p>	<p>Augment by 2</p> <table border="1" data-bbox="474 240 792 384"> <tr><td>4</td><td>0</td><td>0</td><td>2</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>2</td><td>0</td></tr> <tr><td>0</td><td>2</td><td>1</td><td>3</td></tr> </table> <p>Jill = police officer Kevin = radiographer Liz = teacher Mike = nurse</p>	4	0	0	2	0	1	0	0	0	1	2	0	0	2	1	3	<p>M1 A1 B1 B1 [8]</p>	<p>Crossing through zeros using min no of lines and augmenting a second time by min uncovered value (method correct, including entries crossed out twice) Correct augmented matrix (cao) Correctly describing how each table has been formed (eg stating 'reduce rows', 'augment by 1', etc.) Correct allocation (cao) in words or symbols</p>																
4	0	0	2																																
0	1	0	0																																
0	1	2	0																																
0	2	1	3																																
<p>3 (iii)</p>	<p>Remove row for <i>L</i> and column for <i>R</i></p> <table border="1" data-bbox="430 683 958 826"> <tr><td></td><td><i>N</i></td><td><i>P</i></td><td><i>T</i></td></tr> <tr><td><i>J</i></td><td>7</td><td>8</td><td>8</td></tr> <tr><td><i>K</i></td><td>8</td><td>4</td><td>7</td></tr> <tr><td><i>M</i></td><td>8</td><td>3</td><td>4</td></tr> </table> <p>$J = P \quad K = T \quad M = N$</p> <p>This solution involves $8+7+8 = 23$ correct guesses. The maximum possible is 24, but that is not feasible since Kevin and Mike would both need to be the nurse (or Jill would have to be both the police officer and the teacher)</p>		<i>N</i>	<i>P</i>	<i>T</i>	<i>J</i>	7	8	8	<i>K</i>	8	4	7	<i>M</i>	8	3	4	<p>B1 B1 [2]</p>	<p>Or on reduced cost matrix</p> <table border="1" data-bbox="1290 683 1720 826"> <tr><td></td><td><i>N</i></td><td><i>P</i></td><td><i>T</i></td></tr> <tr><td><i>J</i></td><td>3</td><td>2</td><td>2</td></tr> <tr><td><i>K</i></td><td>2</td><td>6</td><td>3</td></tr> <tr><td><i>M</i></td><td>2</td><td>7</td><td>6</td></tr> </table> <p>Same allocation as before except that now Kevin is the teacher (need not see working) A valid explanation, using numbers of guesses or reduced costs (or showing correct use of Hungarian from reduced start matrix, but not just using reduced cost matrix from (ii) with third row and third column removed)</p>		<i>N</i>	<i>P</i>	<i>T</i>	<i>J</i>	3	2	2	<i>K</i>	2	6	3	<i>M</i>	2	7	6
	<i>N</i>	<i>P</i>	<i>T</i>																																
<i>J</i>	7	8	8																																
<i>K</i>	8	4	7																																
<i>M</i>	8	3	4																																
	<i>N</i>	<i>P</i>	<i>T</i>																																
<i>J</i>	3	2	2																																
<i>K</i>	2	6	3																																
<i>M</i>	2	7	6																																

4737

Mark Scheme

January 2013

Question		Answer	Marks	Guidance
4	(i)	A supersource, S , and arc $S S_1$ with lower capacity 13, and upper capacity ≥ 22 .	B1	Or supersource, S , and arc $S S_1$ with $0 \leq$ lower capacity ≤ 13 and upper capacity ≥ 22
		A supersource, S , and arc $S S_2$ with lower capacity 0 and upper capacity ≥ 9	B1 [2]	
4	(ii)	Maximum = $8+10+10-2+15$ = 41 litres per second	M1 A1	Evidence of using -2 for arc BC 41, units not required
		Minimum = $3+1+8-3+2 = 11$ litres per second	B1 [3]	11, units not required
4	(iii)	Arcs crossed in forwards direction: $AD = 10, S_1B = 10, S_2C = 9, ED = 5, ET = 20$ Arcs crossed in backwards direction: $CE = -2, BE = -5$ (AE is crossed twice so any flow is cancelled out) $10+10+9-2-5+5+20 = 47$ (answer given)	M1 A1 [2]	Seeing evidence of -2 and -5 Not including AE (or cancelling it with itself, rather than +8 and -1)

4737

Mark Scheme

January 2013

Question	Answer	Marks	Guidance
4 (iv)		<p>M1</p> <p>A1</p> <p>[2]</p>	<p>May also show arcs from S, ignore the flows on these if shown (should be 13 and 0) (must be flows, not labelling procedure) Arcs S_1A, S_1B, S_2C, AE, CE and DT correct</p> <p>All correct, including direction on DE</p>
4 (v)	<p>$S_1ADT = 6$ $S_2CET = 7$ Total = 13</p>	<p>B1</p> <p>[1]</p>	<p>13, or 6 and 7 or 6+7 (cao)</p>
4 (vi)	<p>Maximum flow = 30 For example, the flow in (iv) plus the extra 13 plus $S_1BEDT = 2$ and $S_2CEDT = 2$</p> <p>Cut $\{S_1, S_2, A, B, C, D, E\}, \{T\}$ is saturated</p>	<p>B1</p> <p>B1</p> <p>[2]</p>	<p>Could 'start from scratch' or give a description of how to 'tweak' the flow</p> <p>B1 30 and a valid flow shown on diagram (assume blanks mean 0, direction not required on DE if no flow in it) <u>Or</u> 30 and a convincing description of flow (do not need to say explicitly that this shows that 30 is feasible)</p> <p>B1 This cut described in any way and some words like 'arcs are full' or '=30' (accept 'max flow = min cut' without further explanation, here)</p>

4737

Mark Scheme

January 2013

Question		Answer	Marks	Guidance																														
5	(i)	4 when he chooses \diamond	B1 [1]	4 and \diamond																														
5	(ii)	<p>\blacklozenge is dominated by \blacksquare</p> <p>Rose always wins more by choosing \blacksquare $(4 > 2, -3 > -5, 4 > -2 \text{ and } 5 > -1)$ Colin should never choose \triangle</p> <table style="margin-left: 20px;"> <tr> <td></td> <td>\circ</td> <td>\square</td> <td>\diamond</td> </tr> <tr> <td>\bullet</td> <td>-2</td> <td>3</td> <td>-4</td> </tr> <tr> <td>\blacksquare</td> <td>4</td> <td>-3</td> <td>4</td> </tr> <tr> <td>\blacktriangle</td> <td>-6</td> <td>5</td> <td>-5</td> </tr> </table>		\circ	\square	\diamond	\bullet	-2	3	-4	\blacksquare	4	-3	4	\blacktriangle	-6	5	-5	B1 M1 A1 [3]	<p>\blacksquare dominates or \blacksquare is <u>always</u> better or correct comparisons seen</p> <p>\triangle</p> <p>This reduced matrix (cao)</p>														
	\circ	\square	\diamond																															
\bullet	-2	3	-4																															
\blacksquare	4	-3	4																															
\blacktriangle	-6	5	-5																															
5	(iii)	<table style="margin-left: 20px;"> <tr> <td></td> <td>\circ</td> <td>\square</td> <td>\diamond</td> <td>row min</td> </tr> <tr> <td>\bullet</td> <td>-2</td> <td>3</td> <td>-4</td> <td>-4</td> </tr> <tr> <td>\blacksquare</td> <td>4</td> <td>-3</td> <td>4</td> <td>-3</td> </tr> <tr> <td>\blacktriangle</td> <td>-6</td> <td>5</td> <td>-5</td> <td>-6</td> </tr> <tr> <td>col</td> <td>4</td> <td>5</td> <td>4</td> <td></td> </tr> <tr> <td>max</td> <td>\uparrow</td> <td></td> <td>\uparrow</td> <td></td> </tr> </table> <p>Play-safe for Rose is \blacksquare</p> <p>Play-safes for Colin are \circ and \diamond</p> <p>Not stable, $4 \neq -3$</p>		\circ	\square	\diamond	row min	\bullet	-2	3	-4	-4	\blacksquare	4	-3	4	-3	\blacktriangle	-6	5	-5	-6	col	4	5	4		max	\uparrow		\uparrow		M1 M1 A1 B1 [4]	<p>Row min values shown</p> <p>Column maxima (or their negatives) shown</p> <p>\blacksquare, \circ and \diamond written down (ft their table), dependent on both M marks</p> <p>Not stable and a valid reason (eg if R plays \blacksquare then C should choose \square) (ft their table, including stable/not stable)</p>
	\circ	\square	\diamond	row min																														
\bullet	-2	3	-4	-4																														
\blacksquare	4	-3	4	-3																														
\blacktriangle	-6	5	-5	-6																														
col	4	5	4																															
max	\uparrow		\uparrow																															

4737

Mark Scheme

January 2013

Question	Answer	Marks	Guidance																																																						
6 (i)	<p>(4; 0) would mean that at the start of Friday morning Simon has no houses in store.</p> <p>He needs four houses for Friday, but he can only make at most three, so he needs at least one in store.</p>	<p>M1</p> <p>A1</p> <p>[2]</p>	<p>Understanding that (4; 0) means no houses stored from Thursday to Friday</p> <p>Explaining why he would need <u>at least</u> one stored, or equivalent</p>																																																						
6 (ii)		<p>B1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>[6]</p>	<p>Arcs correct for Tuesday</p> <p>Arcs correct for Wednesday</p> <p>Arcs correct for Thursday</p> <p>Weights (costs) correct for Friday</p> <p>Weights correct for Tuesday to Thursday (ft arcs, provided 1, 4 or 9)</p> <p>Weights correct for Monday</p>																																																						
6 (iii)	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Stage</th> <th>State</th> <th>Action</th> <th>Working</th> <th>Suboptimal minimum</th> </tr> </thead> <tbody> <tr> <td rowspan="2">4</td> <td>1</td> <td>0</td> <td>9</td> <td>9</td> </tr> <tr> <td>2</td> <td>0</td> <td>4</td> <td>4</td> </tr> <tr> <td rowspan="3">3</td> <td>0</td> <td>1</td> <td>9 + 9 = 18</td> <td>18</td> </tr> <tr> <td rowspan="2">1</td> <td>1</td> <td>4 + 9 = 13</td> <td rowspan="2">13</td> </tr> <tr> <td>2</td> <td>9 + 4 = 13</td> </tr> <tr> <td rowspan="3">2</td> <td>0</td> <td>0</td> <td>4 + 18 = 22</td> <td>22</td> </tr> <tr> <td rowspan="2">1</td> <td>0</td> <td>1 + 18 = 19</td> <td rowspan="2">17</td> </tr> <tr> <td>1</td> <td>4 + 13 = 17</td> </tr> <tr> <td rowspan="3">1</td> <td>0</td> <td>0</td> <td>9 + 22 = 31</td> <td rowspan="2">31</td> </tr> <tr> <td rowspan="2">1</td> <td>0</td> <td>4 + 22 = 26</td> </tr> <tr> <td></td> <td>1</td> <td>9 + 17 = 26</td> </tr> <tr> <td rowspan="2">0</td> <td rowspan="2">0</td> <td>0</td> <td>8 + 31 = 39</td> <td rowspan="2">39</td> </tr> <tr> <td>1</td> <td>27 + 26 = 53</td> </tr> </tbody> </table>	Stage	State	Action	Working	Suboptimal minimum	4	1	0	9	9	2	0	4	4	3	0	1	9 + 9 = 18	18	1	1	4 + 9 = 13	13	2	9 + 4 = 13	2	0	0	4 + 18 = 22	22	1	0	1 + 18 = 19	17	1	4 + 13 = 17	1	0	0	9 + 22 = 31	31	1	0	4 + 22 = 26		1	9 + 17 = 26	0	0	0	8 + 31 = 39	39	1	27 + 26 = 53	<p>[8]</p>	<p>Follow through their part (ii) if possible for M and B marks</p> <p>B1 Columns for stage, state, action and at least one other column for numerical work</p> <p>M1 Stage and state values correct, starting from stage 4</p> <p>A1 Action values correct (= state value for next stage)</p> <p>B1 Suboptimal min values correct for stage 4</p> <p>M1 Correct method for stage 3</p> <p>M1 Correct method for stage 2</p> <p>M1 Correct method for stage 1</p> <p>A1 Completely correct values for suboptimal minima throughout (dependent on all three method marks)</p>
Stage	State	Action	Working	Suboptimal minimum																																																					
4	1	0	9	9																																																					
	2	0	4	4																																																					
3	0	1	9 + 9 = 18	18																																																					
	1	1	4 + 9 = 13	13																																																					
		2	9 + 4 = 13																																																						
2	0	0	4 + 18 = 22	22																																																					
	1	0	1 + 18 = 19	17																																																					
		1	4 + 13 = 17																																																						
1	0	0	9 + 22 = 31	31																																																					
	1	0	4 + 22 = 26																																																						
			1	9 + 17 = 26																																																					
0	0	0	8 + 31 = 39	39																																																					
		1	27 + 26 = 53																																																						
6 (iv)	<p>Mon Tue Wed Thurs Friday</p> <p>2 3 2 3 3</p>	<p>B1</p>	<p>Cao</p>																																																						
		<p>[1]</p>																																																							

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

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

© OCR 2013

