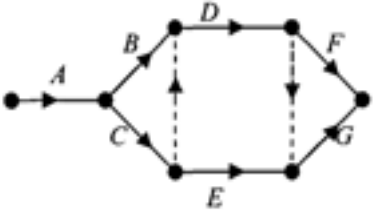
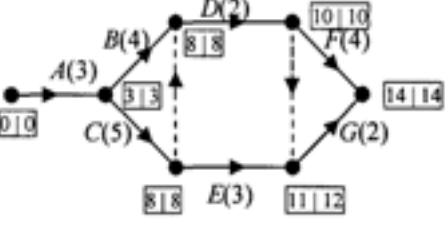
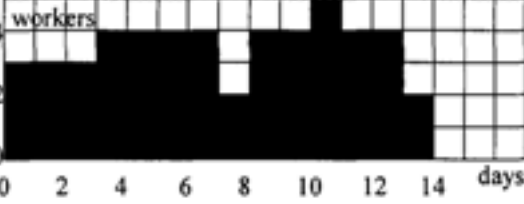


**Mark Scheme 4737
June 2007**

1	(i)	<table border="1"> <thead> <tr> <th></th> <th>house 1</th> <th>house 2</th> <th>house 3</th> <th>house 4</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>500</td> <td>400</td> <td>700</td> <td>600</td> </tr> <tr> <td>B</td> <td>300</td> <td>200</td> <td>400</td> <td>350</td> </tr> <tr> <td>C</td> <td>500</td> <td>300</td> <td>750</td> <td>680</td> </tr> <tr> <td>D</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> </tbody> </table>		house 1	house 2	house 3	house 4	A	500	400	700	600	B	300	200	400	350	C	500	300	750	680	D	0	0	0	0	B1	For copying the table, with row and column headings (accept consistent scalings)
		house 1	house 2	house 3	house 4																								
	A	500	400	700	600																								
	B	300	200	400	350																								
	C	500	300	750	680																								
	D	0	0	0	0																								
				B1	2	For dummy row (Daniel) with all equal values																							
	(ii)	Reduce rows	<table> <tr><td>100</td><td>0</td><td>300</td><td>200</td></tr> <tr><td>100</td><td>0</td><td>200</td><td>150</td></tr> <tr><td>200</td><td>0</td><td>450</td><td>380</td></tr> <tr><td>0</td><td>0</td><td>0</td><td>0</td></tr> </table>	100	0	300	200	100	0	200	150	200	0	450	380	0	0	0	0	M1	For a substantially correct attempt at reducing rows and columns								
	100	0	300	200																									
	100	0	200	150																									
200	0	450	380																										
0	0	0	0																										
	Columns are already reduced		A1	For correct reduced cost matrix (ft scalings) Do not treat as MR																									
	Cross out using two lines			2																									
	Augment by 100	<table> <tr><td>0</td><td>0</td><td>200</td><td>100</td></tr> <tr><td>0</td><td>0</td><td>100</td><td>50</td></tr> <tr><td>100</td><td>0</td><td>350</td><td>280</td></tr> <tr><td>0</td><td>100</td><td>0</td><td>0</td></tr> </table>	0	0	200	100	0	0	100	50	100	0	350	280	0	100	0	0	M1 dep	For a single augmentation by 100 (ft their matrix) (accept either way of augmenting by 100)									
0	0	200	100																										
0	0	100	50																										
100	0	350	280																										
0	100	0	0																										
			A1	ft	For a correct augmented matrix (ft their matrix)																								
				3																									
(ii)	Cross out using three lines		M1	For covering zeros using minimum number of lines a second time, clearly seen or implied from augmenting																									
	Augment by 50	<table> <tr><td>0</td><td>0</td><td>150</td><td>50</td></tr> <tr><td>0</td><td>0</td><td>50</td><td>0</td></tr> <tr><td>100</td><td>0</td><td>300</td><td>230</td></tr> <tr><td>50</td><td>150</td><td>0</td><td>0</td></tr> </table>	0	0	150	50	0	0	50	0	100	0	300	230	50	150	0	0	M1 dep	For a single augmentation by 50 (ft their matrix) (accept either way of augmenting by 50)									
0	0	150	50																										
0	0	50	0																										
100	0	300	230																										
50	150	0	0																										
	Complete matching	<table> <tr><td>0</td><td>0</td><td>150</td><td>50</td></tr> <tr><td>0</td><td>0</td><td>50</td><td>0</td></tr> <tr><td>100</td><td>0</td><td>300</td><td>230</td></tr> <tr><td>50</td><td>150</td><td>0</td><td>0</td></tr> </table>	0	0	150	50	0	0	50	0	100	0	300	230	50	150	0	0	A1	ft	For a correct augmented matrix (ft their matrix)								
0	0	150	50																										
0	0	50	0																										
100	0	300	230																										
50	150	0	0																										
				4																									
(iii)	Allclean should clean house 1 Brightenupp should clean house 4 Clean4U should clean house 2 Cost = £1150		B1	2	For A = 1, B = 4, C = 2 (may also list D = 3) cao																								
			B1	13	For 1150 cao																								

2	(i)	$4p - (1-p)$ $= 5p - 1$ $-2p + 5(1-p) = 5 - 7p$ $4(1-p) = 4 - 4p$	M1 A1	For $4p - 1(1-p)$ or equivalent, seen or implied For $5p - 1$ or $-1 + 5p$ cao
	(ii)		M1 A1 ft A1 ft A1 ft	For any form of this expression cao For any form of this expression cao For correct structure to graph with a horizontal axis that extends from 0 to 1, but not more than this, and with consistent scales. For line $E = 5p - 1$ plotted from (0,-1) to (1, 4) For line $E = 5 - 7p$ plotted from (0, 5) to (1,-2) For line $E = 4 - 4p$ plotted from (0, 4) to (1, 0)
		$p = 0.5$ $5(0.5) - 1$ $= 1.5$ points per game Bea may not play her best strategy	B1 M1 A1 B1	For this or ft their graph For substituting their p into any of their equations (must be seen, cannot be implied from value) For 1.5 cao For this or equivalent
	(iii)	$p = 0.5$ $5(0.5) - 1$ $= 1.5$	B1 M1 A1 B1	For this or ft their graph For substituting their p into any of their equations (must be seen, cannot be implied from value) For 1.5 cao For this or equivalent
	(iv)	1.5 If Amy plays using her optimal strategy, Bea should never play strategy Z Assuming that Bea knows that Amy will make a random choice between P and Q so that each has probability 0.5, it does not matter how she chooses between strategies X and Y.	B1 ft M1 A1	Describing a mixed strategy that involves Z Accept -1.5, ft from (iii) For identifying that she should not play Z For a full description of how she should play (If the candidate assumes that Bea does not know then Bea should play P with probability $\frac{7}{12}$ and Q with probability $\frac{5}{12}$).
			3 15	

<p>3 (i)</p>  <p>A dummy is needed after C because D follows both B and C. A dummy is needed after D because F and G both follow D.</p>	<p>M1 A1 B1 B1</p>	<p>A substantially correct network Condone arrows missing or wrong way round, no end and/or extra dummies Do NOT allow activity on node formulation</p> <p>A correct network, with arrows on at least the dummy activities, with no extra dummies and a single end point.</p> <p>A valid explanation</p> <p>A valid explanation</p>
<p>(ii)</p>  <p>Minimum completion time = 14 days Critical activities are A, C, D, F</p>	<p>M1 A1 M1 A1 B1 B1</p>	<p>A substantially correct forward pass Early event times correct (ft their network if possible)</p> <p>A substantially correct backwards pass Late event times correct (ft their network if possible)</p> <p>For 14 cao For these four activities and no others cao</p>
<p>(iii)</p> 	<p>M1 M1 dep A1 B1</p>	<p>For a reasonable attempt at using the number of workers for the different activities Scales and labels required and some days with 4 workers.</p> <p>For a reasonable attempt with no overhanging blocks</p> <p>For an entirely correct histogram</p>
<p>(iv)</p>	<p>B1 B1</p>	<p>Earliest finish for E > latest start for F</p> <p>For delaying the start of F (by 1 day)</p>
		<p>4 6 3 2 15</p>

4	(i)	stage	state	action	working	minimax		ANSWERED ON INSERT
		1	0	0	4	4		Values only credited when seen in table
			1	0	3	3		
			2	0	2	2		
		2	0	0	$\max(6,4) = 6$	3		
				1	$\max(2,3) = 3$			
				2	$\max(3,2) = 3$			
			1	0	$\max(2,4) = 4$	4	M1	For calculating the maxima as 4, 4, 5
				1	$\max(4,3) = 4$		A1 2	For calculating the minimax as 4
				2	$\max(5,2) = 5$			
		2	0	$\max(2,4) = 4$	3	B1	For completing 4, 3, 2 in the brackets	
			1	$\max(3,3) = 3$		M1	For calculating the maxima as 4, 3, 4 (method)	
			2	$\max(4,2) = 4$		A1 3	For calculating the minimax as 3 cao	
		3	0	0	$\max(5,3) = 5$	3	B1	For using their minimax values from stage 2
				1	$\max(5,4) = 5$		M1	For calculating the maxima for their values
				2	$\max(2,3) = 3$		A1 4	For calculating the maxima as 5, 5, 3 cao For calculating the minimax as 3 cao
	(ii)	3					M1	For the value from their tabulation
							A1	For 3 (irrespective of their tabulation) cao
							M1 dep	For reading route from their tabulation
							A1 4	For this route (irrespective of their tabulation) cao
	(iii)						B1	For the graph structure correct
							M1	For a substantially correct attempt at the weights (no more than two definite errors or omissions)
							A1	For weights unambiguously correct
							3 16	

5	(i)	$S - E - I - T$	B1 1	ANSWERED ON INSERT For this route (not in reverse) cao
	(ii)	6 litres per second From A to G	B1 2	For 6 For direction AG
	(iii)	$6 + 2 + 4 + 0 + 8$ = 20 litres per second	M1 M1 A1 3	For a substantially correct attempt with $DF = 0$ For dealing with $EI (= 8 \text{ or } = 2 + 6)$ For 20 cao Method marks may be implied from answer
	(iv)	eg flow 5 along $S - A - G - T$ and 2 along $S - C - F - H - G - T$	M1 A1 2	For describing a valid flow augmenting route For correctly flowing 7 from S to T
		Diagram correctly augmented	M1 M1 A1 3	For a reasonable attempt at augmenting a flow For correctly augmenting a flow For a correct augmentation by a total of 7
		Cut $\{S, A, B, C, D, E, F, G, H, I\}, \{T\}$	B1	For identifying cut or arcs GT and IT
		This cut has a value of 13 and the flow already found is $6 + 7 = 13$ litres per second. Or This is the maximum flow since the arcs GT and IT are both saturated, so no more can flow into T .	B1 2 13	For explaining how this shows that the flow is a maximum, but NOT just stating max flow = min cut