

Mark Scheme 4737

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4737

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SOLUTIONS

4737

D2

June 2007

FINAL

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

4737

Mark Scheme

June 2007

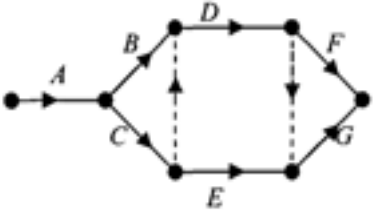
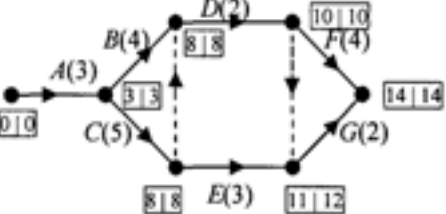

2	(i)	$4p - (1-p)$ $= 5p - 1$	M1	For $4p - 1(1-p)$ or equivalent, seen or implied		
			A1	For $5p - 1$ or $-1 + 5p$	cao	
		$-2p + 5(1-p) = 5 - 7p$	B1	For any form of this expression	cao	
		$4(1-p) = 4 - 4p$	B1	For any form of this expression	cao	
	(ii)		M1	For correct structure to graph with a horizontal axis that extends from 0 to 1, but not more than this, and with consistent scales.		
			A1	ft	For line $E = 5p - 1$ plotted from (0, -1) to (1, 4)	
			A1	ft	For line $E = 5 - 7p$ plotted from (0, 5) to (1, -2)	
			A1	ft	For line $E = 4 - 4p$ plotted from (0, 4) to (1, 0)	
			4	In all three cases, correct or ft from (i)		
		(iii)	$p = 0.5$ $5(0.5) - 1$ $= 1.5$ points per game Bea may not play her best strategy	B1	1	For this or ft their graph
				M1		For substituting their p into any of their equations (must be seen, cannot be implied from value)
				A1		For 1.5
				B1		For this or equivalent
				3	Describing a mixed strategy that involves Z	
	(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	Accept -1.5, ft from (iii)	
			M1		For identifying that she should not play Z	
A1				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

4737

Mark Scheme

June 2007

<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 For these four activities and no others</p>
<p>(iii)</p> 		<p>M1 M1 dep A1</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>E cannot happen until after C has finished so must overlap with F. Start E immediately after C but delay the start of F for 1 day (until after E has finished).</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>

4737

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June 2007

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					
		(0; 0) - (1; 1) - (2; 2) - (3; 0) (or in reverse)		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				

4737

Mark Scheme

June 2007

5	(i)	$S - E - I - T$	B1	1	ANSWERED ON INSERT
	(ii)	6 litres per second From A to G	B1		For this route (not in reverse) cao
	(iii)	$6 + 2 + 4 + 0 + 8$ = 20 litres per second	B1	2	For 6
					For direction AG
			M1		For a substantially correct attempt with $DF = 0$
			M1		For dealing with $EI (= 8 \text{ or } 2 + 6)$
			A1	3	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		For describing a valid flow augmenting route
		Diagram correctly augmented	A1	2	For correctly flowing 7 from S to T
		Diagram correctly augmented	M1		For a reasonable attempt at augmenting a flow
			M1		For correctly augmenting a flow
			A1	3	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		For explaining how this shows that the flow is a maximum, but NOT just stating max flow = min cut
				2	
				13	