



ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Mark scheme January 2004

GCE

Mathematics A

Unit MAD2

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Key to mark scheme

M	mark is for	method
m	mark is dependent on one or more M marks and is for	method
A	mark is dependent on M or m mark and is for	accuracy
B	mark is independent of M or m marks and is for	method and accuracy
E	mark is for	explanation
✓ or ft or F		follow through from previous incorrect result
CAO		correct answer only
AWFW		anything which falls within
AWRT		anything which rounds to
AG		answer given
SC		special case
OE		or equivalent
A2,1		2 or 1 (or 0) accuracy marks
- x EE		Deduct x marks for each error
NMS		No method shown
PI		Perhaps implied
c		Candidate

Abbreviations used in marking

MC - x	deducted x marks for miscopy
MR - x	deducted x marks for misread
ISW	ignored subsequent working
BOD	gave benefit of doubt
WR	work replaced by candidate

Application of mark scheme

Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise

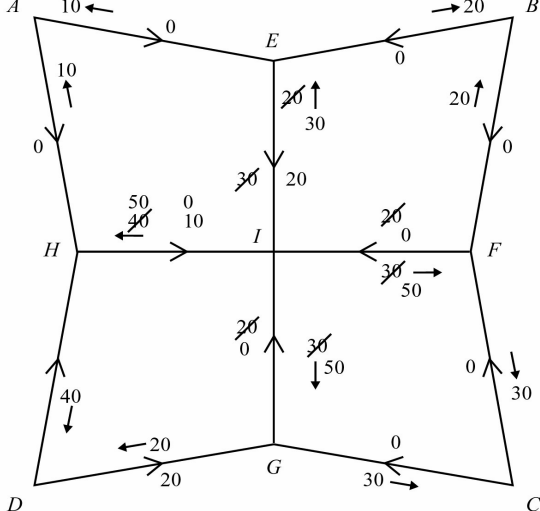
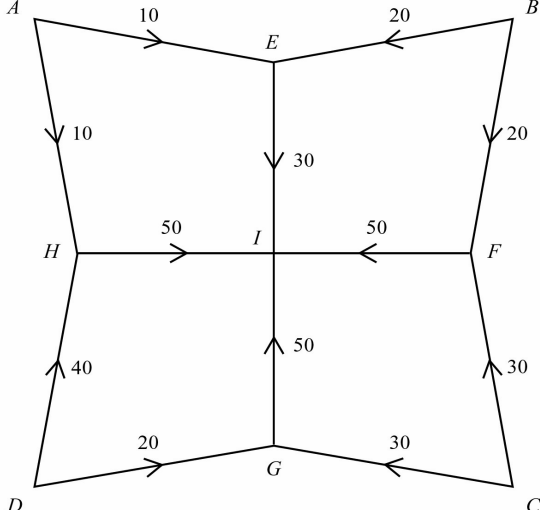
Award method and accuracy marks as appropriate to an alternative solution using a correct method or partially correct method.

Q	Solution	Marks	Total	Comments	
1	$\begin{bmatrix} 1 & 3 & 2 & 1 \\ 8 & 10 & 9 & 10 \\ 7 & 9 & 8 & 7 \\ 3 & 2 & 4 & 1 \end{bmatrix} \begin{matrix} 1 \\ 8 \\ 7 \\ 1 \end{matrix}$	M1			
		A1			
	$\begin{bmatrix} 0 & 2 & 1 & 0 \\ 0 & 2 & 1 & 2 \\ 0 & 2 & 1 & 0 \\ 2 & 1 & 3 & 0 \end{bmatrix}$	M1			
	$\begin{matrix} 0 & 1 & 1 & 0 \end{matrix}$				
	$\left[\begin{array}{ccc c} 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 2 \\ 0 & 1 & 0 & 0 \\ 2 & 0 & 2 & 0 \end{array} \right]$	A1		OE	
	4 lines = optimal				
	Match: Michael $\rightarrow A$ Rick $\rightarrow B$ Hilary $\rightarrow C$ Edwina $\rightarrow D$				or $E \rightarrow A$ $R \rightarrow B$ $H \rightarrow C$ $M \rightarrow D$
		B1			or $H \rightarrow A$ $R \rightarrow B$ $M \rightarrow C$ $E \rightarrow D$
					or $E \rightarrow C$ $H \rightarrow A$ $M \rightarrow D$ $R \rightarrow B$
	Total = 19				
		B1	6		
	Total		6		

Q	Solution	Marks	Total	Comments
2 (a)(i)		<p>M1 A1 M1 A1</p>	<p>2 2</p>	<p>Forward Back</p>
(ii)				
(b)	<p>CP = A C E G K Min time = 26</p>	<p>B1</p>	<p>1</p>	<p>Both</p>
(c)	<p>B, D</p>	<p>B1</p>	<p>1</p>	

Q	Solution	Marks	Total	Comments
2 (d)		M1 A2	3	-1 EE
(e)(i)	Min time = 28 1 worker critical path other activities \Rightarrow J takes until 24 \therefore overrun = 2	B1 E1	2	
(ii)	A C E G K and B D F (H) I J	B1	1	H either
	Total		12	

Q	Solution	Marks	Total	Comments
3	<p>Route: <i>ADCEFILKM</i></p>	<p>M1</p> <p>A1</p> <p>A1F</p> <p>A1F</p> <p>A1F</p> <p>B1</p> <p>B1</p>	<p>7</p>	<p>Working Backwards</p> <p>SCA M1</p> <p>7 at L A1</p> <p>17 at I A1F</p> <p>43 at E A1F</p> <p>47 at D A1F</p> <p>at C</p> <p>at E</p> <p>at I</p> <p>at K</p> <p>for 54</p>
Total			7	

Q	Solution	Marks	Total	Comments
4 (a)	A, B, C, D	B1	1	
(b)	I	B1	1	
(c)	$20+20+10+10+40+50+30$	M1		
	$= 180$	A1	2	
(d)		M1		SCA
		M1		1 complete flow
Final:		A1		OE

Q	Solution	Marks	Total	Comments																																																																							
5 (a)(i)	All ≥ 0	B1	1																																																																								
	(ii) $P = 2.4$ $n = 0.4, y = 0.2, z = 0$	B1																																																																									
		B1	2	All three																																																																							
	(b)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>x</th> <th>y</th> <th>z</th> <th>r</th> <th>s</th> <th>P</th> <th></th> </tr> </thead> <tbody> <tr> <td>3</td> <td>4</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> <td>2</td> </tr> <tr> <td>1</td> <td>3</td> <td>2</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>-3</td> <td>-6</td> <td>-2</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>5</td> <td>0</td> <td>-2</td> <td>1</td> <td>-1</td> <td>0</td> <td>2</td> </tr> <tr> <td>1</td> <td>3</td> <td>2</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>-1</td> <td>0</td> <td>2</td> <td>0</td> <td>2</td> <td>1</td> <td>2</td> </tr> <tr> <td>5</td> <td>0</td> <td>-2</td> <td>1</td> <td>-1</td> <td>0</td> <td>2</td> </tr> <tr> <td>0</td> <td>15</td> <td>12</td> <td>-1</td> <td>6</td> <td>0</td> <td>3</td> </tr> <tr> <td>0</td> <td>0</td> <td>8</td> <td>1</td> <td>9</td> <td>5</td> <td>12</td> </tr> </tbody> </table>	x	y	z	r	s	P		3	4	2	1	0	0	2	1	3	2	0	1	0	1	-3	-6	-2	0	0	1	0	5	0	-2	1	-1	0	2	1	3	2	0	1	0	1	-1	0	2	0	2	1	2	5	0	-2	1	-1	0	2	0	15	12	-1	6	0	3	0	0	8	1	9	5	12	M1A1		Tableau
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Total			12																																																																								

Q	Solution	Marks	Total	Comments
6 (a)(i)	Row min (-2, 2 -3)	M1		
	Max 2			
	Column max (3, 5, 2, 6)			
	Min 2	A1		
	2 = 2, therefore stable solution	E1	3	
	(ii) 1 saddle point at (2, 3)	B1	1	
	(b) Colin plays I with prob p , II with $(1-p)$	M1		
	Return $p(x+2)+3(1-p)$	A1		
	$p(x-1)+5(1-p)$	A1		
	$p(x-1)+3 = \frac{19}{5}$	M1		equating to value
	$p(x-6)+5 = \frac{19}{5}$			
	$p(x-1) = \frac{4}{5}$	A1		or solving for p first
$p(x-6) = -\frac{6}{5}$	A1			
$\frac{4}{5(x-1)} = \frac{-6}{5(x-6)}$	M1			
$4x - 24 = -6x + 6$				
$x = 3$	A1	8	CAO	
	Total		12	
	Total		60	