GCE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

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 marks 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 ..... possibly implied
SCA ..... substantially correct approach
c ..... candidate
SF ..... significant figure(s)
DP ..... decimal place(s)

Abbreviations used in Marking

MC – *x* ..... deducted *x* marks for mis-copy
MR – *x* ..... deducted *x* marks for mis-read
ISW ..... ignored subsequent working
BOD ..... given benefit of doubt
WR ..... work replaced by candidate
FB ..... formulae booklet

Application of Mark Scheme

No method shown:
Correct answer without working ..... mark as in scheme
Incorrect answer without working ..... zero marks unless specified otherwise

More than one method/choice of solution:

2 or more complete attempts, neither/none crossed out	mark both/all fully and award the mean mark rounded down
1 complete and 1 partial attempt, neither crossed out	award credit for the complete solution only

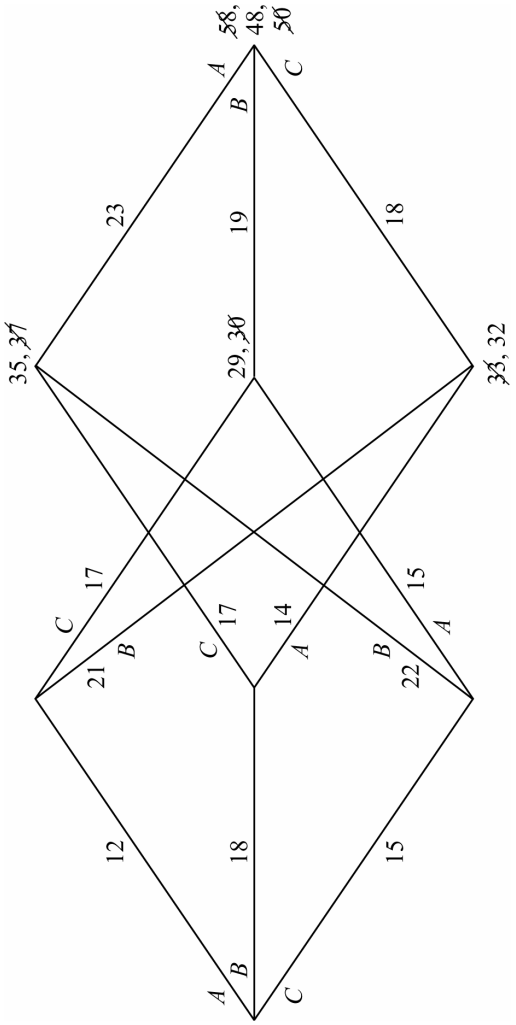
Crossed out work do not mark unless it has not been replaced

Alternative solution using a correct or partially correct method award method and accuracy marks as appropriate

MAD2

Q	Solution	Marks	Total	Comments
1	Stage State Action Value 1 A 1 12	M1		Full Network
	B 1 18	M1		SCA
	C 1 15			
	2 A & B 1 $12+21=33$			Or network diagram (see alternative)
	2 $18+14=\underline{32}$	M1		
	A & C 1 $12+17=\underline{29}$	A1×3		
	2 $15+15=30$			
	B & C 1 $18+17=\underline{35}$			
	2 $15+22=37$			
	3 A, B, C, 1 $32+18=50$			
	2 $29+19=48$	M1		3 individuals
	3 $35+23=58$			
	$\therefore$ Route ACB	B1		Or working back Stage 1 18, 19, 23 Stage 2 (39, $\underline{36}$) ($\underline{32}$, 40) (45, $\underline{34}$)
	Min time = 48	B1	9	Stage 3 ($\underline{48}$, 50, 49)
	Total		**9**	

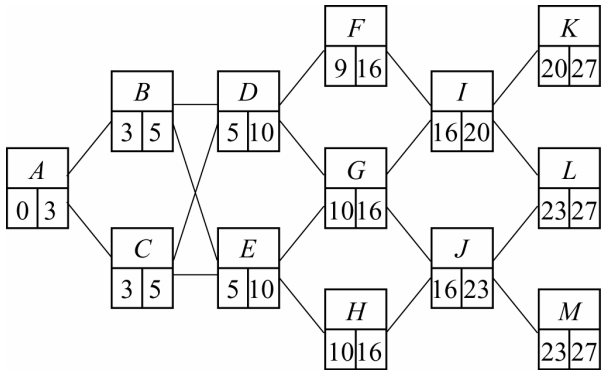
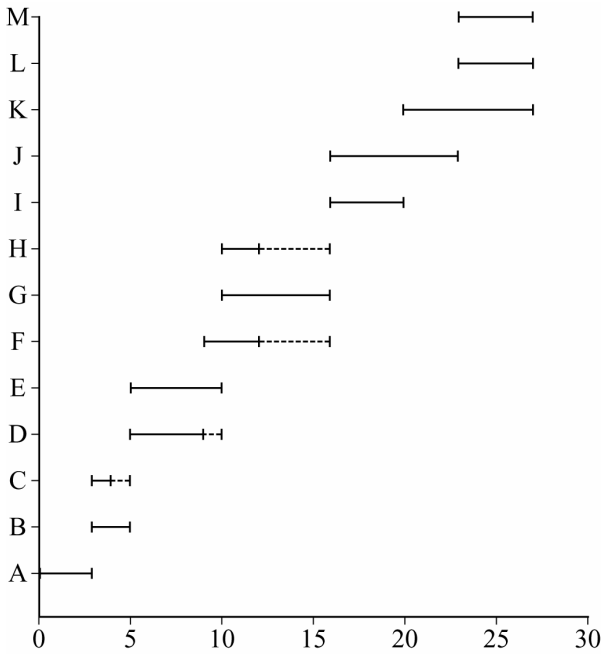
MAD2 (Cont)

Q	Solution	Marks	Total	Comments
1	**Alternative**			
		*(M1)* *(M1)* *(M1)* *(A3)* *(M1)*		*SCA* Full network 3 pairs 3 values at end
	Route *ACB* Min = 48	*(B1)* *(B1)*		

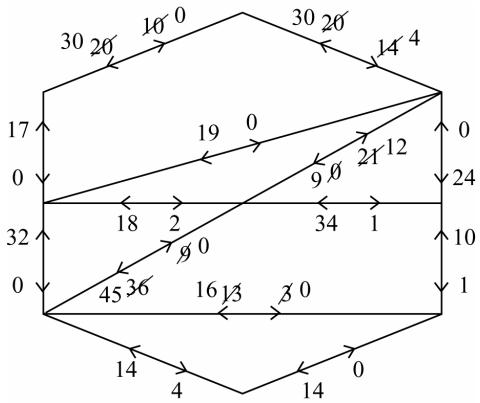
MAD2 (Cont)

Q	Solution	Marks	Total	Comments
2	Change matrix to 4 5 7 4 5 4 6 5 7 3 10 7 2 0 1 2 (2) (0) (1) (2) 2 5 6 2 (2) 3 4 5 3 (3) 5 3 9 5 (3) 0 0 0 5 (0) 0° 3 4 0 0 1 2 0° 2 0° 6 2 0 0 0° 0 4 lines ∴ Match ∴ *AG, BS, CH, DL* 15 14 16 18 = 63	M1 M1 A1 M1 A1 B1 B1 B1	8	SC if minimised M0 M1 A1 M1 A1 B0 B1 + B1 (available) Or *AS, BG*
	Total		**8**	

MAD2 (Cont)

Q	Solution	Marks	Total	Comments
3(a)(i)		M1 A1	2	Forward
(ii)		M1 A1	2	Back
(b)	*C, H, F, D*	B1	1	
(c)		M1 A2	3	(–1 EE)
(d)(i)	Extra at *KLM* Min extra 4 Total = 31	M1 A1	2	
(ii)	*A B D F H I K* *C E G J L M*	B1 B1	2	OE
	Total		**12**	

MAD2 (Cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	Source *A* , *C*	B1	1	
(ii)	Sink *G, I*	B1	1	
(b)(i)	Flow = 100	B1	1	
(ii)	x = 14	B1	1	
(iii)	y = 34	B1	1	
(c)	Flow = <u>122</u>	B1		
		M1 M1 A1 M1 A1	 6	Initial diagram SCA 1 flow;OE 2nd flow All correct;OE
	Total		**11**	

MAD2 (Cont)

Q	Solution	Marks	Total	Comments
5(a)	$\begin{array}{cccccc\|c} x & y & z & r & s & P & \\ \hline 1 & 3^\circ & 2 & 1 & 0 & 0 & 11 \\ 3 & 4 & 2 & 0 & 1 & 0 & 21 \\ -3 & -6 & -2 & 0 & 0 & 1 & 0 \end{array}$	B2,1,0	2	Or equivalent
(b)	$\begin{array}{cccccc\|c} 1 & 3 & 2 & 1 & 0 & 0 & 11 \\ 5^\circ & 0 & -2 & -4 & 3 & 0 & 19 \\ -1 & 0 & 2 & 2 & 0 & 1 & 22 \end{array}$	M1		Row reduction
		M1		Pivot
		A1		All correct
	$\begin{array}{cccccc\|c} 0 & 15 & 12 & 9 & -3 & 0 & 36 \\ 5 & 0 & -2 & -4 & 3 & 0 & 19 \\ 0 & 0 & 8 & 6 & 3 & 5 & 129 \end{array}$	M1		Row reduction
		M1		Pivot
		A1		All correct
	$P = \frac{129}{5} = \underline{25.8}$	B1		
	$z = 0,\ x = \frac{19}{5},\ y = \frac{12}{5}$	B1	8	
	Alternative to Question 5			
5(a)	$\begin{array}{cccccc\|c} P & x & y & z & r & s & \\ \hline 1 & -3 & -6 & -2 & 0 & 0 & 0 \\ 0 & 1 & 3^\circ & 2 & 1 & 0 & 11 \\ 0 & 3 & 4 & 2 & 0 & 1 & 21 \end{array}$	*(B2,1,0)*		Or equivalent
(b)	$\begin{array}{cccccc\|c} 1 & -1 & 0 & 2 & 2 & 0 & 22 \\ 0 & 1 & 3 & 2 & 1 & 0 & 11 \\ 0 & 5 & 0 & -2 & -4 & 3 & 19 \end{array}$	*(M1)*		Row reduction
		(M1)		Pivot
		(A1)		All correct
	$\begin{array}{cccccc\|c} 5 & 0 & 0 & 8 & 6 & 3 & 129 \\ 0 & 0 & 15 & 12 & 9 & -3 & 36 \\ 0 & 5 & 0 & -2 & -4 & 3 & 19 \end{array}$	*(M1)*		Row reduction
		(M1)		Pivot
		(A1)		All correct
	$P = \frac{129}{5} = 25.8$	*(B1)*		
	$z = 0\ \ x = \frac{19}{5},\ y = \frac{12}{5}$	*(B1)*		Or equivalent
	Total		**10**	

MAD2 (Cont)

Q	Solution	Marks	Total	Comments
6(a)	Min rows $\begin{bmatrix}1\\1\\2\end{bmatrix}$ Max = 2	M1		
	Max cols Min = 4			
	(7, 4, 6)	A1		
	$2 \neq 4$	E1	3	
(b)	III > II	B1		
	$\begin{bmatrix}1 & 3 & 6\\7 & 4 & 2\end{bmatrix}$	B1	2	
(c)	Let Bev play with p, q, $1-p-q$	M1		
	$p+3q+6(1-p-q) = 3\frac{3}{5}$	A1		A1 without $\left(=3\frac{3}{5}\right)$
	$7p+4q+2(1-p-q) = 3\frac{3}{5}$	A1		
	$-5p-3q = -2\frac{2}{5}$			
	$5p+2q = 1\frac{3}{5}$			
	$\Rightarrow q = \frac{4}{5},\ p = 0$	A1		
	Plays I prob 0			
	II prob $\frac{4}{5}$			
	III prob $\frac{1}{5}$	B1	5	All three
	Total		**10**	
	Total		**60**	