

GCE 2004

June Series



Mark Scheme

Mathematics A

Unit MAD2

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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Dr Michael Cresswell Director General

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	M1 A1×3		Or network diagram (see alternative)
			2	18 + 14 = <u>32</u>			
		A & C	1	12 + 17 = <u>29</u>			
			2	15 + 15 = 30			
		B & C	1	18 + 17 = <u>35</u>			
			2	15 + 22 = <u>37</u>			
3	A, B, C,	1	32 + 18 = 50	M1		3 individuals	
		2	29 + 19 = 48				
		3	35 + 23 = 58				
	∴ Route ACB			B1		Or working back Stage 1 18, 19, 23 Stage 2 (39, <u>36</u>) (<u>32</u> , 40) (45, <u>34</u>) Stage 3 (<u>48</u> , 50, 49)	
	Min time = 48			B1	9		
	Total					9	

MAD2 (Cont)

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

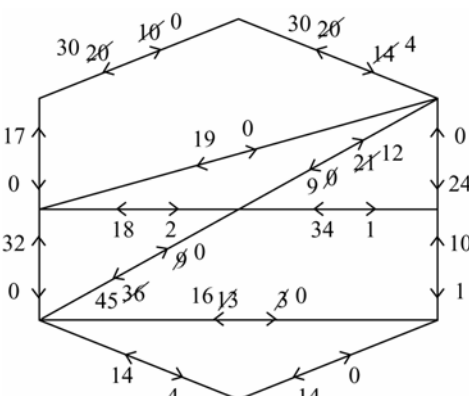
MAD2 (Cont)

Q	Solution	Marks	Total	Comments
2	Change matrix to $\begin{matrix} 4 & 5 & 7 & 4 \\ 5 & 4 & 6 & 5 \\ 7 & 3 & 10 & 7 \\ 2 & 0 & 1 & 2 \end{matrix}$ <hr/> $\begin{matrix} (2) & (0) & (1) & (2) \\ 2 & 5 & 6 & 2 & (2) \\ 3 & 4 & 5 & 3 & (3) \\ 5 & 3 & 9 & 5 & (3) \\ 0 & 0 & 0 & 5 & (0) \end{matrix}$ <hr/> $\begin{matrix} 0^\circ & 3 & 4 & 0 \\ 0 & 1 & 2 & 0^\circ \\ 2 & 0^\circ & 6 & 2 \\ 0 & 0 & 0^\circ & 0 \end{matrix}$ 4 lines \therefore Match $\therefore AG, BS, CH, DL$ $\begin{matrix} 15 & 14 & 16 & 18 \\ & & & = \underline{63} \end{matrix}$	M1 M1 A1 M1 A1 B0 B1 + B1 (available) 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)	<i>C, H, F, D</i>	B1	1	
(c)		M1 A2	3	(-1 EE)
(d)(i)	Extra at <i>KLM</i> Min extra 4 Total = 31	M1 A1	2	
(ii)	<i>A B D F H I K</i>	B1		
	<i>C E G J L M</i>	B1	2	OE
Total			12	

MAD2 (Cont)

Q	Solution	Marks	Total	Comments
4(a)(i) (ii)	Source A, C Sink G, I	B1 B1	1 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 2 nd 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)	$\begin{array}{cccccc c} 1 & 3 & 2 & 1 & 0 & 0 & 11 \\ 5^\circ & 0 & -2 & -4 & 3 & 0 & 19 \\ -1 & 0 & 2 & 2 & 0 & 1 & 22 \end{array}$ $\begin{array}{cccccc c} 0 & 15 & 12 & 9 & -3 & 0 & 36 \\ 5 & 0 & -2 & -4 & 3 & 0 & 19 \\ 0 & 0 & 8 & 6 & 3 & 5 & 129 \end{array}$ $P = \frac{129}{5} = 25.8$ $z = 0, x = \frac{19}{5}, y = \frac{12}{5}$	M1 M1 A1 M1 M1 A1		Row reduction Pivot All correct Row reduction Pivot All correct
	<p><u>Alternative to Question 5</u></p>			
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)	$\begin{array}{cccccc c} 1 & -1 & 0 & 2 & 2 & 0 & 22 \\ 0 & 1 & 3 & 2 & 1 & 0 & 11 \\ 0 & 5 & 0 & -2 & -4 & 3 & 19 \end{array}$ $\begin{array}{cccccc c} 5 & 0 & 0 & 8 & 6 & 3 & 129 \\ 0 & 0 & 15 & 12 & 9 & -3 & 36 \\ 0 & 5 & 0 & -2 & -4 & 3 & 19 \end{array}$ $P = \frac{129}{5} = 25.8$ $z = 0, x = \frac{19}{5}, y = \frac{12}{5}$	(M1) (M1) (A1) (M1) (M1) (A1)		Row reduction Pivot All correct Row reduction Pivot All correct
	$P = \frac{129}{5} = 25.8$ $z = 0, x = \frac{19}{5}, y = \frac{12}{5}$	(B1) (B1)	8	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) $2 \neq 4$	A1 E1	3	
(b)	III > II $\begin{bmatrix} 1 & 3 & 6 \\ 7 & 4 & 2 \end{bmatrix}$	B1 B1	2	
	(c) Let Bev play with $p, q, 1 - p - q$ $p + 3q + 6(1 - p - q) = 3\frac{3}{5}$ $7p + 4q + 2(1 - p - q) = 3\frac{3}{5}$ $-5p - 3q = -2\frac{2}{5}$ $5p + 2q = 1\frac{3}{5}$ $\Rightarrow q = \frac{4}{5}, p = 0$ Plays I prob 0 II prob $\frac{4}{5}$ III prob $\frac{1}{5}$	M1 A1 A1 A1		A1 without $\left(= 3\frac{3}{5}\right)$
	Total		5	All three
	Total		10	
	Total		60	