

GCE 2005

January Series



Mark Scheme

Mathematics A

(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.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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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 mean mark	mark both/all fully and award the
crossed out	rounded down
1 complete and 1 partial attempt, neither crossed out solution only	award credit for the complete

Crossed out work replaced

do not mark unless it has not been

Alternative solution using a correct or partially correct method

award method and accuracy marks as appropriate

MAD2

Q	Solution	Marks	Total	Comments
1	$\begin{array}{cccc} 23 & 27 & 21 & 26 \\ 28 & 28 & 26 & 27 \\ 24 & 25 & 23 & 24 \\ 26 & 24 & 23 & 21 \\ \hline (23) & (24) & (21) & (21) \end{array}$ $\begin{array}{cccc} 0 & 3 & 0 & 5 & (0) \\ 5 & 4 & 5 & 6 & (4) \\ 1 & 1 & 2 & 3 & (1) \\ 3 & 0 & 2 & 0 & (0) \end{array}$ $\begin{array}{cccc} 0 & 3 & [0] & 5 \\ 1 & [0] & 1 & 2 \\ [0] & 0 & 1 & 2 \\ 3 & 0 & 2 & [0] \end{array}$ Match 1C, 2B, 3A, 4D Min = 94	 M1 A1 M1 A1 B1 B1	 6 6	 OR Rows first $\begin{array}{cccc} 2 & 6 & 0 & 5 \\ 2 & 2 & 0 & 1 \\ 1 & 2 & 0 & 1 \\ 5 & 3 & 2 & 0 \\ (1) & (2) & (0) & (0) \end{array}$ $\begin{array}{cccc} 1 & 4 & 0 & 5 \\ 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 4 & 1 & 2 & 0 \end{array}$
	Total		6	

MAD2 (cont)

Q	Solution	Marks	Total	Comments
2(a)		<p>M1 A1</p> <p>M1 A1</p>	<p>2</p> <p>2</p>	<p>Forward pass</p> <p>Back pass</p>
(b)	Critical path <i>ABEGILM</i>	B1	1	
(c)	<i>D</i>	B1	1	
(d)	(C now 9, so E starts at 14)	M1		SC 32 scores 1/2
	Overrun 2 days	A1	2	
(e)	<i>F</i> start at 14	M1A1		SC 35 scores 2/3
	∴ overrun 5 days	A1	3	
	Total		11	

MAD2 (cont)

Q	Solution	Marks	Total	Comments
3(a)	$M \xrightarrow{45} G \xrightarrow{70} \text{delay} \xrightarrow{65}$ $\text{Rome} \xrightarrow{80} \text{delay} \xrightarrow{40} \text{Palermo}$	M1 A1	2	
3(b)		M1 M1 M1 M1 A2,1,0 A1		SCA Using delays 3 values at T or R or V 3 values at P Values at T, R, V At P Or working backwards $\begin{array}{r} 125 \\ 120 \\ \hline 252 \\ 250 \\ \hline 248 \\ 255 \\ \hline (255) \\ (255) \\ \hline 265 \\ 259 \\ 260 \\ \hline 298 \\ 300 \\ 298 \end{array}$ M1 SCA M1 Delays M1 3 values A2,1,0 M1 3 values A1 + B1B1
	Route $MSVP = 298$	B1B1	9	
Total			11	

MAD2 (cont)

Q	Solution	Marks	Total	Comments																																																									
4(a)	$C_1 = 100 + 80 + 150$ $= 330$ $C_2 = 80 + 80 + 100 + 80 + 80$ $= 420$	B1 B1	2	OE																																																									
(b)		M1 A1 A1	3																																																										
(c)(i)	At I max = 300 \therefore restriction \Rightarrow max = 120	B1	1																																																										
(ii)	At H max = 150 \therefore restriction \Rightarrow max = 270	M1 A1	2																																																										
Total			8																																																										
5(a)	<table style="border-collapse: collapse; margin-left: 20px;"> <tr> <td style="border-right: 1px solid black; padding: 5px;">x</td> <td style="border-right: 1px solid black; padding: 5px;">y</td> <td style="border-right: 1px solid black; padding: 5px;">s</td> <td style="border-right: 1px solid black; padding: 5px;">t</td> <td style="border-right: 1px solid black; padding: 5px;">u</td> <td style="border-right: 1px solid black; padding: 5px;">P</td> <td style="padding: 5px;"></td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">2</td> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="padding: 5px;">20</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">[2]</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="padding: 5px;">20</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">5</td> <td style="border-right: 1px solid black; padding: 5px;">4</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="padding: 5px;">60</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">-2</td> <td style="border-right: 1px solid black; padding: 5px;">-3</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="padding: 5px;">0</td> </tr> </table>	x	y	s	t	u	P		2	1	1	0	0	0	20	1	[2]	0	1	0	0	20	5	4	0	0	1	0	60	-2	-3	0	0	0	1	0	M1 A1	2																							
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1	[2]	0	1	0	0	20																																																							
5	4	0	0	1	0	60																																																							
-2	-3	0	0	0	1	0																																																							
(b)	<table style="border-collapse: collapse; margin-left: 20px;"> <tr> <td style="border-right: 1px solid black; padding: 5px;">3</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">2</td> <td style="border-right: 1px solid black; padding: 5px;">-1</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="padding: 5px;">20</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">2</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="padding: 5px;">20</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">[3]</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">-2</td> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="padding: 5px;">20</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">-1</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">3</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">2</td> <td style="padding: 5px;">60</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">2</td> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">-1</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="padding: 5px;">0</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">6</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">5</td> <td style="border-right: 1px solid black; padding: 5px;">-1</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="padding: 5px;">40</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">3</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">-2</td> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="padding: 5px;">20</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">0</td> <td style="border-right: 1px solid black; padding: 5px;">7</td> <td style="border-right: 1px solid black; padding: 5px;">1</td> <td style="border-right: 1px solid black; padding: 5px;">6</td> <td style="padding: 5px;">200</td> </tr> </table>	3	0	2	-1	0	0	20	1	2	0	1	0	0	20	[3]	0	0	-2	1	0	20	-1	0	0	3	0	2	60	0	0	2	1	-1	0	0	0	6		0	5	-1	0	40	3	0	0	-2	1	0	20	0	0	0	7	1	6	200	M1 M1 A1		Correct use of their pivot Row reduction
3	0	2	-1	0	0	20																																																							
1	2	0	1	0	0	20																																																							
[3]	0	0	-2	1	0	20																																																							
-1	0	0	3	0	2	60																																																							
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0	6	0	5	-1	0	40																																																							
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0	0	2	1	-1	0	0																																																							
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3	0	0	-2	1	0	20																																																							
0	0	0	7	1	6	200																																																							
	$P = \frac{100}{3}$	B1																																																											
	$x = \frac{20}{3}$ $y = \frac{20}{3}$	B1B1	9																																																										
Total			11																																																										

MAD2 (cont)

Q	Solution	Marks	Total	Comments
6(a)	For A Row I > Row III Or row II > Row III	E1	1	
(b)(i)	A plays I prob p II prob $1-p$ Returns are $4p + 2(1-p) = 2 + 2p$ $-p + 3(1-p) = 3 - 4p$ $2p + (1-p) = 1 + p$	M1 A2,1,0		
		M1 A1		
	$3 - 4p = 1 + p \Rightarrow p = \frac{2}{5}$	A1		
	Hence I $-\frac{2}{5}$ II $-\frac{3}{5}$	B1	7	
(ii)	$\therefore V = 1 + \frac{2}{5} = \frac{7}{5}$	B1	1	

MAD2 (cont)

Q	Solution	Marks	Total	Comments
6(c)	For B play I prob p II prob q $p = 0$ $-q + 2(1 - q) \left(= \frac{7}{5} \right)$ $3q = \frac{3}{5}$ $q = \frac{1}{5}$	M1 M1A1 A1	4	Or III prob $1 - p - q$ Returns are $4p - q + 2(1 - p - q) \left(= \frac{7}{5} \right)$ A1 $2p + 3q + (1 - p - q) \left(= \frac{7}{5} \right)$ $\Rightarrow 2p - 3q = -\frac{3}{5}$ M1 $p + 2q = \frac{2}{5}$ $\therefore q = \frac{1}{5}, p = 0$ Or $p = 0$ M1 $-1q + 2(1 - q) = 3q + 1 - q$ M1A1 $2 - 3q = 2q + 1$ $1 = 5q$ $\frac{1}{5} = q$ A1
	Total		13	
	Total		60	