



General Certificate of Education

Mathematics 6300

Specification A

MAD2 Discrete 2

Mark Scheme

2005 examination - June series

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.

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	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 book

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(a)		M1	2	forward pass	
		A1			
		M1	2		back pass
		A1			
	B1	1			
	B1	1			
		M1		3	Gantt diagram
		B1			floats included
		A1			correct, excluding floats
	(e)(i)	<p>D 5 days \Rightarrow G back 2 days</p> <p>$\therefore J$ starts at 35</p> <p>$\therefore L$ starts at 43</p> <p>\therefore finish at 55</p>		E1	3
M1					
A1					
(ii)	$ADGIJL$	B1		1	
Total				13	

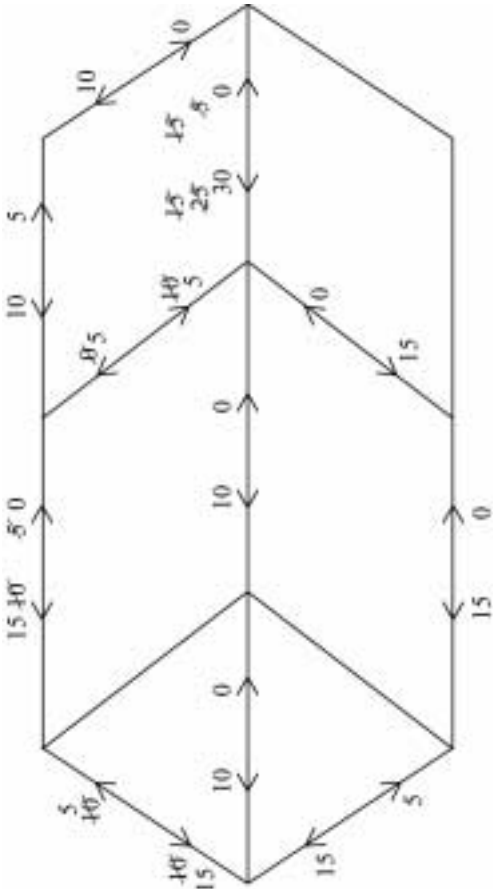
MAD2 (cont)

Q	Solution	Marks	Total	Comments	
2	18 24 26 22 28	M1		add column of 28+ or 15–	
	17 25 23 19 28	A1			
	19 26 24 23 28				
	16 22 28 20 28				
	20 23 22 21 28				
	(16) (22) (22) (19) (28)				
	$\begin{array}{ccccc c} 2 & 2 & 4 & 3 & 0 & \\ \hline 1 & 3 & 1 & 0 & 0 & \\ 3 & 4 & 2 & 4 & 0 & \\ \hline 0 & 0 & 6 & 1 & 0 & \\ \hline 4 & 1 & 0 & 2 & 0 & \end{array}$	M1			row/column reduction
	Reduce by 2	A1			(either order)
	$\begin{array}{ccccc} \cancel{0} & \cancel{0} & \cancel{2} & \cancel{1} & \cancel{0} \\ \cancel{1} & \cancel{3} & \cancel{1} & \cancel{0} & \cancel{2} \\ \cancel{1} & \cancel{2} & \cancel{0} & \cancel{2} & \cancel{0} \\ \cancel{0} & \cancel{0} & \cancel{6} & \cancel{1} & \cancel{2} \\ \cancel{4} & \cancel{1} & \cancel{0} & \cancel{2} & \cancel{2} \end{array}$	M1			column/row reduction
	5 lines on diagram, or statement	A1			
∴ match A1, B4, D2, E3	B1	or A2, D1			
18 + 19 + 22 + 22 = 81	B1	9			
Total			9		

MAD2 (cont)

Q	Solution	Marks	Total	Comments
3	<p>Minimum cost = 47</p> <p>Route <i>A C D E G H I J L</i></p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1F</p> <p>A1F</p> <p>B1</p> <p>B1</p>	<p>8</p> <p>8</p>	<p>SCA (or stage/state)</p> <p>correct at <i>D</i></p> <p>3 values at <i>H</i></p> <p>3 values at <i>L</i></p> <p>correct values at <i>H</i></p> <p>correct values at <i>L</i></p> <p>if working backwards:</p> <p>M1 SCA</p> <p>A1 correct at <i>I</i></p> <p>M1 3 values at <i>E</i></p> <p>M1 3 values at <i>A</i></p> <p>A1 correct at <i>E</i></p> <p>A1 correct at <i>A</i></p> <p>or reverse</p>
Total			8	

MAD2 (cont)

Q	Solution	Marks	Total	Comments
4(a)	 <p data-bbox="287 1299 782 1344">∴ maximum flow = 40</p>	<p data-bbox="821 291 885 324">M1</p> <p data-bbox="821 358 885 392">A1</p> <p data-bbox="821 425 885 459">A1</p> <p data-bbox="821 1299 885 1332">B1</p> <p data-bbox="821 1377 885 1411">B1</p> <p data-bbox="821 1433 885 1467">B1</p> <p data-bbox="821 1500 885 1534">B1</p>	<p data-bbox="933 1299 981 1332">4</p> <p data-bbox="933 1377 981 1411">1</p> <p data-bbox="933 1545 981 1579">2</p>	<p data-bbox="1037 291 1101 324">SCA</p> <p data-bbox="1037 358 1149 392">first flow</p> <p data-bbox="1037 425 1181 459">second flow</p>
Total			7	

MAD2 (cont)

Q	Solution	Marks	Total	Comments									
5(a)	For A, III > I	E1	2	or II > III									
	For B, I > III	E1											
(b)	<table style="margin-left: 40px;"> <tr> <td></td> <td>I</td> <td>II</td> </tr> <tr> <td>p</td> <td>3</td> <td>1</td> </tr> <tr> <td>$1-p$</td> <td>2</td> <td>3</td> </tr> </table>		I	II	p	3	1	$1-p$	2	3	M1		sight of $p, 1-p$
		I	II										
	p	3	1										
	$1-p$	2	3										
	If Ben plays I: return $3p+2(1-p) (=p+2)$	M1		$kp+c(1-p)$; their $(1-p)$									
	If Ben plays II: return $p+3(1-p) (=3-2p)$	A1		both correct									
	$\therefore p+2=3-2p$ $3p=1$ $p=\frac{1}{3} \left(1-p=\frac{2}{3}\right)$	A1											
	Value of games $1=2\frac{1}{3}$	B1F											
	<table style="margin-left: 40px;"> <tr> <td></td> <td>q</td> <td>$1-q$</td> </tr> <tr> <td>I</td> <td>3</td> <td>1</td> </tr> <tr> <td>II</td> <td>2</td> <td>3</td> </tr> </table>		q	$1-q$	I	3	1	II	2	3	M1		sight of $q, 1-q$
		q	$1-q$										
I	3	1											
II	2	3											
If Arnie plays I: return $3q+1(1-q)=2q+1$	M1		$kq+c(1-q)$; their $(1-q)$										
If Arnie plays II: return $2q+3(1-q)=-q+3$ $\therefore 2q+1=-q+3$	A1		or $2q+1=2\frac{1}{3}$										
$q=\frac{2}{3} \left(1-q=\frac{1}{3}\right)$	A1	9	$q=\frac{2}{3}$										
Total			11										

MAD2(cont)

Q	Solution	Marks	Total	Comments
6(a)	x y z r s t P 3 6 1 1 0 0 0 72 4 2 1 0 1 0 0 48 1 -1 1 0 0 1 0 36 -2 3 -1 0 0 0 1 0	M1 A1	2	a tableau
	(b) Pivot x , 4 0 18 1 4 -3 0 0 144 4 2 1 0 1 0 0 48 0 -6 3 0 -1 4 0 96 0 8 -1 0 1 0 2 48 Pivot z , 3 0 60 0 12 -8 -4 0 336 12 12 0 0 4 -4 0 48 0 -6 3 0 -1 4 0 96 0 18 0 0 2 4 6 240 All non-negative in the P row \therefore optimal $P = 40$ $x = 4, y = 0, z = 32$ $s = t = 0$ $r = 28$	M1 M1 A1 M1 M1 A1 E1 B1 B1 B1		
Total			12	
TOTAL			60	