Version 1.0: 0805

ASSESSMENT and QUALIFICATIONS ALLIANCE

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)

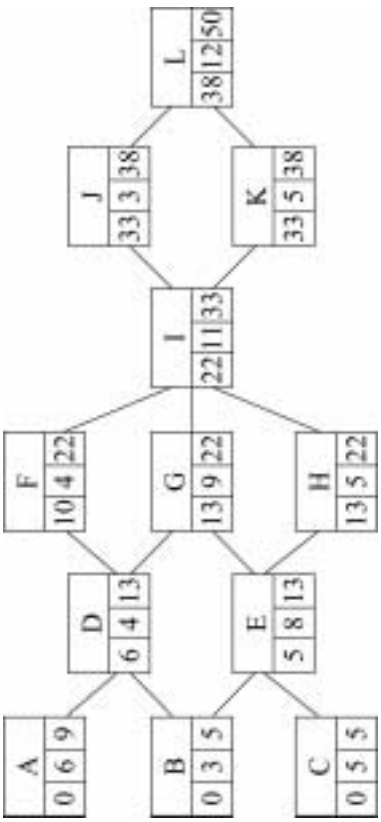
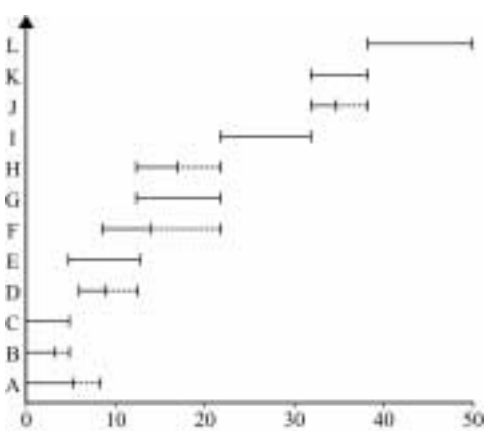
Abbreviations used in Marking

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

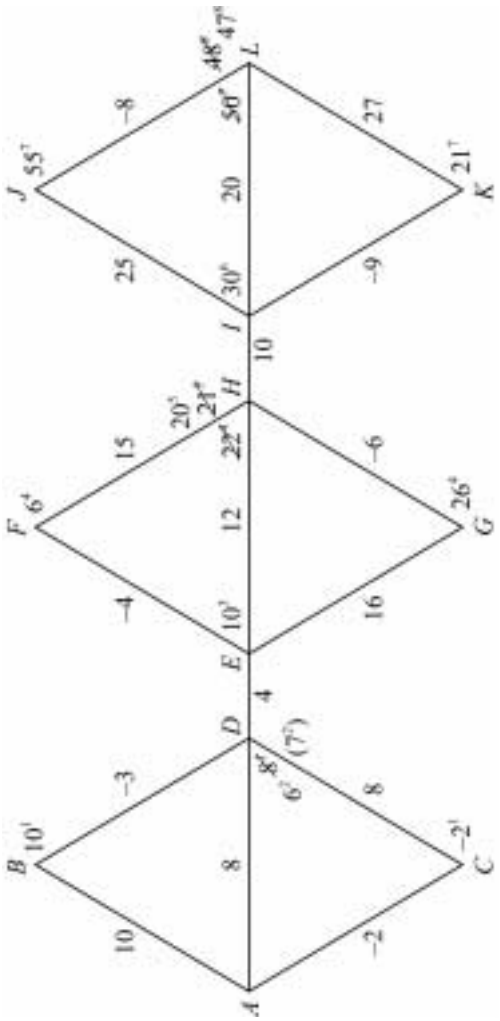
MAD2

Q	Solution	Marks	Total	Comments
1(a)		M1 A1 M1 A1	 2 2	forward pass back pass
(b)	*C E G I K L*	B1	1	
(c)	*F*	B1	1	
(d)		M1 B1 A1	 3 	Gantt diagram floats included correct, excluding floats
(e)(i)	*D* 5 days $\Rightarrow$ *G* back 2 days $\therefore$ *J* starts at 35 $\therefore$ *L* starts at 43 $\therefore$ finish at 55	E1 M1 A1	 3	 OE
(ii)	*A D G I J L*	B1	1	
	Total		**13**	

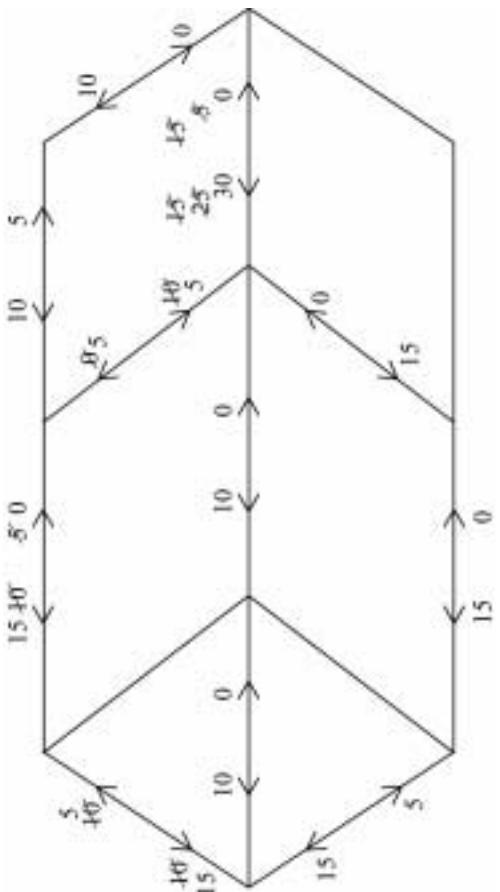
MAD2 (cont)

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)			
	2 2 4 3 0 1 3 1 0 0 3 4 2 4 0 0 0 6 1 0 4 1 0 2 0	M1 A1		row/column reduction (either order)
	Reduce by 2			
	~~0• 0 2 1 0~~ ~~1 3 1 0• 2~~ ~~1 2 0 2 0•~~ ~~0 0• 6 1 2~~ ~~4 1 0• 2 2~~	M1 A1		column/row reduction
	5 lines on diagram, or statement	B1		
	∴ match *A*1, *B*4, *D*2, *E*3	B1		or *A*2, *D*1
	18 + 19 + 22 + 22 = 81	B1	9	
	Total		**9**	

MAD2 (cont)

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

MAD2 (cont)

Q	Solution	Marks	Total	Comments
4(a)		M1 A1 A1		SCA first flow second flow
	∴ maximum flow = 40	B1	4	
(b)	Cut *BE*, *DG*, *CF*	B1	1	
(c)	Out of *A* – max 50 ∴ from *A* must be road Same as *J* ∴ join *AJ* direct	B1 B1	2	
	Total		**7**	

MAD2 (cont)

Q	Solution	Marks	Total	Comments
5(a)	For A, III > I	E1		
	For B, I > III	E1	2	or II > III
(b)	I II p 3 1 $1-p$ 2 3	M1		sight of p, $1-p$
	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		
	q $1-q$ I 3 1 II 2 3	M1		sight of q, $1-q$
	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)	$x \quad y \quad z \quad r \quad s \quad t \quad P$			
	$3 \quad 6 \quad 1 \quad 1 \quad 0 \quad 0 \quad 0 \quad 72$ $4 \quad 2 \quad 1 \quad 0 \quad 1 \quad 0 \quad 0 \quad 48$ $1 \quad -1 \quad 1 \quad 0 \quad 0 \quad 1 \quad 0 \quad 36$ $-2 \quad 3 \quad -1 \quad 0 \quad 0 \quad 0 \quad 1 \quad 0$	M1 A1	2	a tableau
(b)	Pivot x, 4	M1		
	$0 \quad 18 \quad 1 \quad 4 \quad -3 \quad 0 \quad 0 \quad 144$ $4 \quad 2 \quad 1 \quad 0 \quad 1 \quad 0 \quad 0 \quad 48$ $0 \quad -6 \quad 3 \quad 0 \quad -1 \quad 4 \quad 0 \quad 96$ $0 \quad 8 \quad -1 \quad 0 \quad 1 \quad 0 \quad 2 \quad 48$	M1 A1		row reduction
	Pivot z, 3	M1		
	$0 \quad 60 \quad 0 \quad 12 \quad -8 \quad -4 \quad 0 \quad 336$ $12 \quad 12 \quad 0 \quad 0 \quad 4 \quad -4 \quad 0 \quad 48$ $0 \quad -6 \quad 3 \quad 0 \quad -1 \quad 4 \quad 0 \quad 96$ $0 \quad 18 \quad 0 \quad 0 \quad 2 \quad 4 \quad 6 \quad 240$	M1 A1		row reduction
	All non-negative in the P row $\therefore$ optimal	E1		
	$P = 40$	B1		
	$x = 4,\ y = 0,\ z = 32$ $s = t = 0$	B1		
	$r = 28$	B1	10	
	Total		**12**	
	TOTAL		**60**	