



General Certificate of Education

Mathematics 6360

MD01 Discrete 1

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 and abbreviations used in marking

M	mark is for method		
m or dM	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	MC	mis-copy
CAO	correct answer only	MR	mis-read
CSO	correct solution only	RA	required accuracy
AWFW	anything which falls within	FW	further work
AWRT	anything which rounds to	ISW	ignore subsequent work
ACF	any correct form	FIW	from incorrect work
AG	answer given	BOD	given benefit of doubt
SC	special case	WR	work replaced by candidate
OE	OE	FB	formulae book
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme
-x EE	deduct x marks for each error	G	graph
NMS	no method shown	c	candidate
PI	possibly implied	sf	significant figure(s)
SCA	substantially correct approach	dp	decimal place(s)

Application of Mark Scheme

No method shown:

Correct answer without working
Incorrect answer without working

mark as in scheme
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

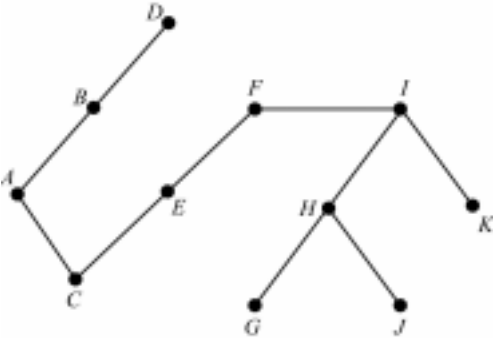
Alternative solution using a correct or partially correct method

award method and accuracy marks as
appropriate

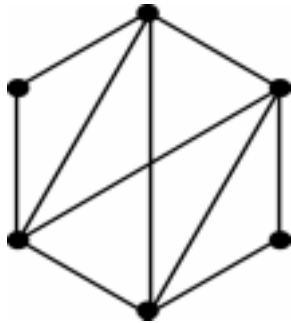
MD01

Q	Solution	Marks	Total	Comments
1(a)	$\underline{23 \quad 3 \quad 17 \quad 4 \quad 6 \quad 19 \quad 14 \quad 3}$	M1	5	All correct
	$\underline{3 \quad 23 \quad 17 \quad 4 \quad 6 \quad 19 \quad 14 \quad 3}$	A1		
	$\underline{3 \quad 17 \quad 23 \quad 4 \quad 6 \quad 19 \quad 14 \quad 3}$	m1		
	$\underline{3 \quad 4 \quad 17 \quad 23 \quad 6 \quad 19 \quad 14 \quad 3}$	A1		
	$\underline{3 \quad 4 \quad 6 \quad 17 \quad 23 \quad 19 \quad 14 \quad 3}$			
	$\underline{3 \quad 4 \quad 6 \quad 17 \quad 19 \quad 23 \quad 14 \quad 3}$			
	$\underline{3 \quad 4 \quad 6 \quad 14 \quad 17 \quad 19 \quad 23 \quad 3}$			
	$3 \quad 3 \quad 4 \quad 6 \quad 14 \quad 17 \quad 19 \quad 23$	A1		
Total			5	
2(a)		M1 A1	2	Bipartite graph
	<p>(b) Initially KP, MJ, NA</p> <p>Paths $G \rightarrow A \rightarrow N \rightarrow F$</p> <p>$S \rightarrow J \rightarrow M \rightarrow R$</p> <p>Match GA, NF, SJ, MR, KP</p> <p>Or GP, KF, MR, SJ, NA</p>	B1 M1 A1 M1 A1 B1	6	Starting with G, F, S, R 1 st pass path starting G,F 2 nd pass path starting S,R Or $G \rightarrow P \rightarrow K \rightarrow F$ Or $S \rightarrow A \rightarrow N \rightarrow F$ $G \rightarrow A \rightarrow S \rightarrow J \rightarrow M \rightarrow R$
Total			8	

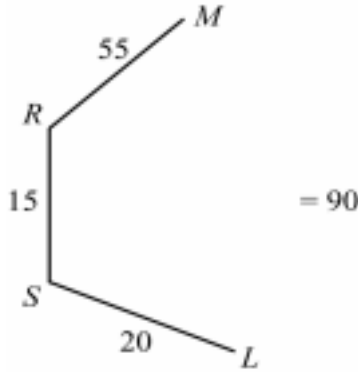
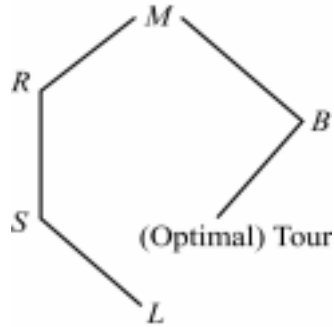
MD01 (cont)

Q	Solution	Marks	Total	Comments																																																		
3(a)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">AB</td> <td style="width: 10%;">or</td> <td style="width: 15%;">20</td> <td style="width: 15%;"></td> <td style="width: 45%;"></td> </tr> <tr> <td>AC</td> <td></td> <td>25</td> <td></td> <td>SCA</td> </tr> <tr> <td>BD</td> <td></td> <td>30</td> <td></td> <td>10 edges</td> </tr> <tr> <td>CE</td> <td></td> <td>35</td> <td></td> <td>BD third</td> </tr> <tr> <td>EF</td> <td></td> <td>40</td> <td></td> <td>CE fourth</td> </tr> <tr> <td>FI</td> <td></td> <td>35</td> <td></td> <td></td> </tr> <tr> <td>HI</td> <td></td> <td>30</td> <td>A1</td> <td>5</td> </tr> <tr> <td>IK</td> <td></td> <td>35</td> <td></td> <td>All correct</td> </tr> <tr> <td>HG</td> <td></td> <td>40</td> <td></td> <td></td> </tr> <tr> <td>HJ</td> <td></td> <td>45</td> <td></td> <td></td> </tr> </table>	AB	or	20			AC		25		SCA	BD		30		10 edges	CE		35		BD third	EF		40		CE fourth	FI		35			HI		30	A1	5	IK		35		All correct	HG		40			HJ		45					
AB	or	20																																																				
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HG		40																																																				
HJ		45																																																				
(b)	335	B1	1																																																			
(c)		<p>B1 M1 A1</p>	3	10 edges																																																		
(d)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">Add AE</td> <td style="width: 10%;"></td> <td style="width: 15%;">+40</td> <td style="width: 15%;"></td> <td style="width: 45%;"></td> </tr> <tr> <td>Delete CE</td> <td></td> <td>-35</td> <td></td> <td>Adding AE, deleting CE/CA</td> </tr> <tr> <td>Extra</td> <td></td> <td>+5</td> <td>A1</td> <td>2</td> </tr> </table>	Add AE		+40			Delete CE		-35		Adding AE, deleting CE/CA	Extra		+5	A1	2			15 with no working (M1, A0)																																			
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Delete CE		-35		Adding AE, deleting CE/CA																																																		
Extra		+5	A1	2																																																		
Total			11																																																			

MD01 (cont)

Q	Solution	Marks	Total	Comments															
4(a)(i)	21	B1	1																
(ii)	6	B1	1																
(iii)	7	B1	1																
(b)(i)	All vertices are even	E1	1	OE															
(ii)	n odd	E1	1																
(c)		M1 A1	2	Graph with 6 vertices															
Total			7																
5(a)(i)	<table style="border-collapse: collapse; margin-left: 20px;"> <thead> <tr> <th style="border-bottom: 1px solid black; padding: 2px;">X</th> <th style="border-bottom: 1px solid black; padding: 2px;">K</th> <th style="border-bottom: 1px solid black; padding: 2px;">Y</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;">2</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">5</td> </tr> <tr> <td style="padding: 2px;">5</td> <td style="padding: 2px;">2</td> <td style="padding: 2px;">4.1</td> </tr> <tr> <td style="padding: 2px;">4.1</td> <td style="padding: 2px;">3</td> <td style="padding: 2px;">4.001</td> </tr> <tr> <td style="padding: 2px;">4.001</td> <td style="padding: 2px;">4</td> <td></td> </tr> </tbody> </table>	X	K	Y	2	1	5	5	2	4.1	4.1	3	4.001	4.001	4		M1 A1 A1 A1	4	SCA (either part) $Y = 5$ $Y = 4.1$ All correct
X	K	Y																	
2	1	5																	
5	2	4.1																	
4.1	3	4.001																	
4.001	4																		
(ii)	<table style="border-collapse: collapse; margin-left: 20px;"> <thead> <tr> <th style="border-bottom: 1px solid black; padding: 2px;">X</th> <th style="border-bottom: 1px solid black; padding: 2px;">K</th> <th style="border-bottom: 1px solid black; padding: 2px;">Y</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;">-6</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">-4.33(3)</td> </tr> <tr> <td style="padding: 2px;">-4.33(3)</td> <td style="padding: 2px;">2</td> <td style="padding: 2px;">-4.01(3)</td> </tr> <tr> <td style="padding: 2px;">-4.01(3)</td> <td style="padding: 2px;">3</td> <td style="padding: 2px;">-4.000</td> </tr> <tr> <td style="padding: 2px;">-4.000</td> <td style="padding: 2px;">4</td> <td></td> </tr> </tbody> </table>	X	K	Y	-6	1	-4.33(3)	-4.33(3)	2	-4.01(3)	-4.01(3)	3	-4.000	-4.000	4		A1 A1 A1	3	$Y = -4.33(\dots)$ Can be fractions $Y = -4.01(\dots)$ All correct
X	K	Y																	
-6	1	-4.33(3)																	
-4.33(3)	2	-4.01(3)																	
-4.01(3)	3	-4.000																	
-4.000	4																		
(b)	Continuous loop	B1	1																
Total			8																

MD01 (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	$S \rightarrow R \rightarrow M \rightarrow B \rightarrow L \rightarrow S$ 15 55 25 50 20 = 165	M1 A1	2	Adding 5 numbers
	(ii) $S \rightarrow R \rightarrow L \rightarrow B \rightarrow M \rightarrow S$ 15 25 50 25 90 = 205	M1 M1 A1 B1	4	Tour Visits all vertices Correct order
(b)	 <p style="text-align: center;">= 90</p>	M1		SCA (mst and 2 edges)
		m1		3 edges
		A1		Correct mst
		m1 A1	5	
(c)	 <p style="text-align: center;">(Optimal) Tour</p>	B1F E1	2	ft if M1 awarded in (b) Either
		Total		13

MD01 (cont)

Q	Solution	Marks	Total	Comments
7(a)		<p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p></p> <p></p> <p></p> <p>6</p> <p></p> <p></p>	<p>If reverse</p> <p>M1 SCA</p> <p>M1 2 values at W</p> <p>A1 both correct</p> <p>M1 2 values at R</p> <p>A1 all correct</p> <p>B1 400</p> <p>SCA</p> <p>2 correct values at G</p> <p>2 values at C</p> <p>2 values at T</p> <p>All correct</p> <p>400 at L</p> <p>B1 1</p> <p>M1</p> <p>A1</p> <p>B1 3</p>
(ii)	R S G W M C L	B1	1	
(b)	<p>Possible</p> <p>R C L = 410</p> <p>R S G W T L = 415</p> <p>Extra time = 10 minutes</p> <p>R C L</p>	<p>M1</p> <p>A1</p> <p>B1</p>	<p></p> <p></p> <p>3</p>	<p>Considering both routes</p> <p>410 and 415</p>
Total			10	

MD01 (cont)

Q	Solution	Marks	Total	Comments
8(a)	Milky $12x + 18y \leq 600$ $\Rightarrow 2x + 3y \leq 100$	B1	1	
(b)	$x \geq 15, y \geq 15$ $x + y \geq 35$ $20x + 10y \leq 600$ (P =) $1.5x + y$	B1 B1 B1 B1	4	OE
(c)		B1 B1×3 B1 B1	6	$x \geq 15, y \geq 15$ Other 3 lines Feasible Region Objective Line
(d)	Considering one of their extreme points $P = 50$	M1 A1	2	
Total			13	
Total			75	