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General Certificate of Education (A-level)
January 2012

Mathematics MD01

(Specification 6360)

Decision 1

Final

Mark Scheme

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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Key to mark scheme abbreviations

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
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
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)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

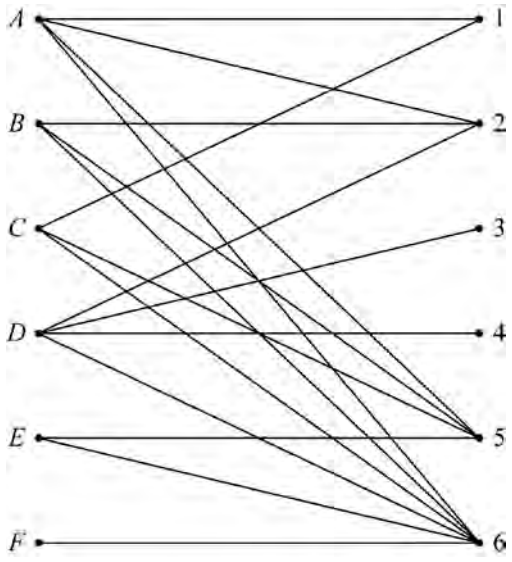
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

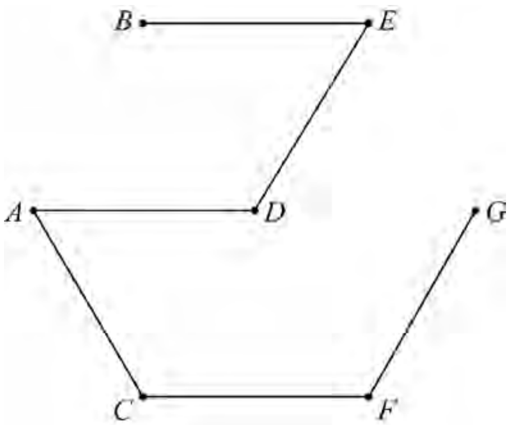
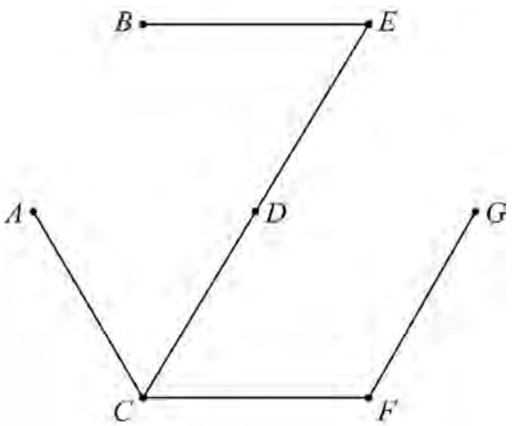
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

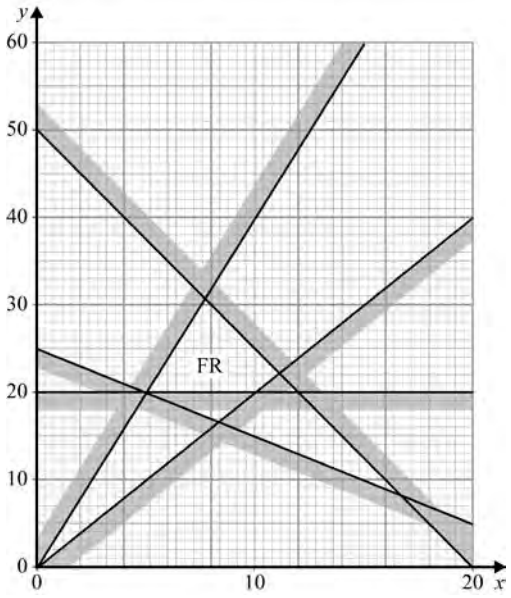
MD01

Q	Solution	Marks	Total	Comments
1	37 25 16 12 36 24 13 11 − ~ × • − ~ × • 36 37 24 25 13 16 11 12	M1		Using 4 sets of 2
	36 24 13 11 37 25 16 12 − × − × − × − ×	A1		Must see this line
	13 16 36 37 11 12 24 25	m1		Using 2 sets of 4
	13 11 16 12 36 24 37 25	A1		Must see this line
	11 12 13 16 24 25 36 37	A1	5	All correct
	Total		**5**	
2(a)		M1		Bipartite graph, 2 sets of 6 vertices, at least 10 edges
		A1	2	Correct, including labels
(b)	F must be with 6 $\therefore$ E must be with 5	E1		
	$\therefore$ B must be with 2	E1		
	$\therefore A \& C$ both with 1 Impossible as two people cannot be allocated to the same task	E1	3	Include conclusion Or E1 3 must be with D (generous) E1 4 " " " D (generous) E1 Impossible as D cannot do both 3 and 4 (strict)
	Total		**5**	

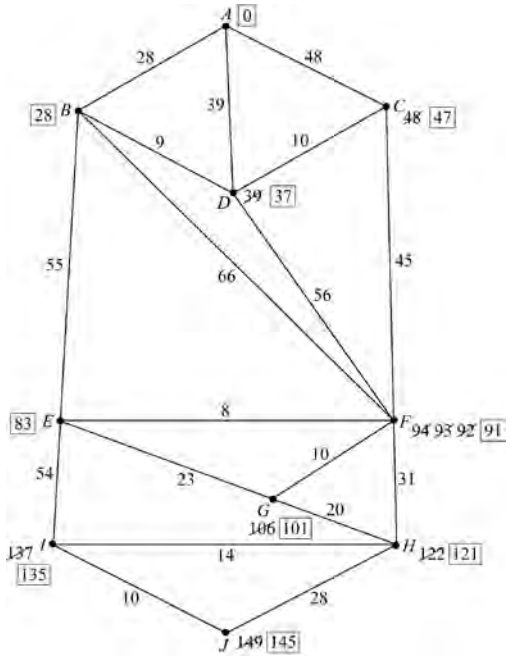
MD01 (cont)

Q	Solution	Marks	Total	Comments
3(a)	$ED = 6$ $AC = 8$ $AD = 10$ or $DC = 10$ $FG = 11$ $BE = 12$ $CF = 16$	M1 A1 A1 B1 A1	 5	Kruskal, must have first 2 edges correct & no cycles (edges **not** lengths must be seen) *AD* or *CD* third edge *BE* 5th edge 6 edges All correct
(b)	63	B1	1	
(c)		M1 A1		Spanning tree with 5+ edges Correct including labelling
		A1	3	Correct including labelling on a separate diagram
	Total		**9**	
4(a)	$CE + KH = (35 + 24) = 59$ $CK + EH = (25 + 40) = 65$ $CH + EK = (25 + 30) = 55$	M1 A2,1		These 3 correct sets of pairs 3 correct totals, 2 correct totals
	Total $= 224 + 55$ PI by their '279' $= 279$	M1 A1	 5	224 + their smallest of three pair totals CSO including totals seen
(b)	3	B1	1	
	Total		**6**	

MD01 (cont)

Q	Solution	Marks	Total	Comments
5(a)				Each line must be straight to have the B mark available. For all lines, must be correct to ½ square horizontal and vertical at the indicated vertices.
		B1		$y = 20$
		B1		line through (4,40) and (16,10)
		B1		line through (0,25) and (10,15)
		M1		any line through origin (or if extended, through the origin) with positive gradient (generous ± 1 square at the origin)
		A1		lines through (10,20) **and** (10,40) as well as origin (normal accuracy rules)
		B1	6	FR, all lines correct and region labelled (condone no shading, ignore 'poor' shading)
(b)(i)	$(\text{Min at})\ x = 5, y = 20$	B1		Accept (5, 20)
	$(\text{P} =)\ 45$	B1		
(ii)	$(\text{Min at})\ x = 10, y = 20$	B1		Accept (10, 20)
	$(\text{P} =)\ 10$	B1	4	
	Total		**10**	

MD01 (cont)

Q	Solution	Marks	Total	Comments
6(a)		M1 A1 m1 m1 m1 A1 B1	 7	SCA, 2 values at *C* or *D* Correct values at *D* 4 values at *F* 2 values at *G* or *H* 2 values at *I* Each m1 depends only on the M1 All correct, condone 0 missing at *A*, with rejected values crossed and final values boxed and no extra values at other vertices. 145 at *J*
(b)	Route: *A B E F G H I J*	B1	1	Or reverse
(c)	'their 135' – (28 + *GJ*) *GJ* may be in terms of letters or numbers = 63 Route: *A B G H I J*	M1 A1 B1	 3	**or** replace their *BG* in terms of letters or numbers eg 55 + 8 + 10 = 73, then 'their 73' – 10 =… **or** *BG* = *AG* – 10 – 28 eg *BG* = 'their 101' – 10 – 28 Note: 63 with no working seen scores 2/2 Or reverse
	Total		**11**	

MD01 (cont)

Q	Solution	Marks	Total	Comments
7(a)				
		B1		5 correct values in an *E* 'line'
		B1	2	All correct
(b)(i)	*BADEFGCB*	M1		Tour visiting at least 6 vertices
		A1		Visits all 7 vertices
		A1		Correct order from *B*
	80	B1	4	
(ii)	*B A D E F G E C A B*	M1		Expansion of *GC* or *CB*
		A1	2	Both correct
(iii)	76	B1F	1	Minimum of 76 and their (b)(i)
(c)(i)		M1		Use of matrix form, 4+ numbers circled and 4+ parallel 'lines' crossed out
		A1		*C* added 4th
		B1		Any 5 values 'circled'
		A1		All correct values circled and lines crossed out, either as shown or as mirror image. Order of vertices must be clearly shown. Condone omission of line at *G*.
			4	
(ii)	43	B1		For 43 seen, or for 2 + 6 + 3 + 12 + 20
	43 + (4 + 7)	M1		Their 43 + 2 different edges from *E*
	= 54	A1	3	SC 54 with no working 2/3
(iii)	64	B1	1	
(d)	$64 \leqslant T \leqslant 76$	B1B1	2	Must be written in symbols
	Total		**19**	

MD01 (cont)

Q	Solution	Marks	Total	Comments
8(a)	$2x+3>0$ $3x-5>0$ $x+1>0$ $4x-13>0$	M1		Any of these seen Candidates may use ≥ 1 instead of >0
	$x > \frac{13}{4}$ or $\geq \frac{14}{4}$ (Integer) so $x \geq 4$	A1	2	Must see both lines. Ignore further work on other inequalities. Accept 4.6 or 4.7 AWRT
(b)(i)	$2x+3 > 3x-5$	M1		Any correct ISW, condone use of $\geq$
	$> x+1$	A1		2nd correct ISW
	$> 4x-13$	A1	3	All correct ISW
(ii)	$3x-5>x+1$	M1		Either correct ISW, condone use of $\geq$
	$> 4x-13$	A1	2	Both correct ISW
(iii)	$x+1>4x-13$	B1	1	ISW
(c)	$\frac{13}{4}<x<\frac{14}{3}$	M1		Or $4 \leq x < \frac{14}{3}$, condone $3 < x < \frac{14}{3}$ (Ignore all other inequalities)
	$x=4$	A1	2	Must have scored 9/9 earlier SC $x < \frac{14}{3} \therefore x=4$ 1/2
	Total		**10**	
	TOTAL		**75**	