Version

General Certificate of Education (A-level)
June 2012

Mathematics MD01

(Specification 6360)

Decision 1

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.

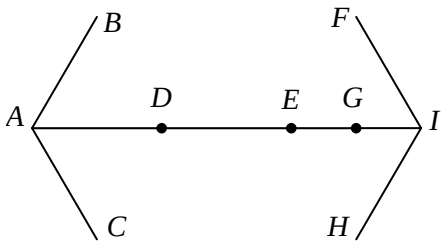
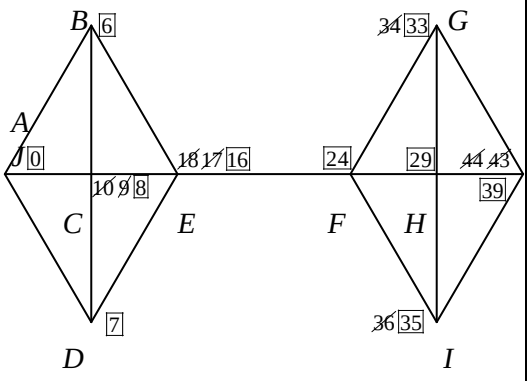
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn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

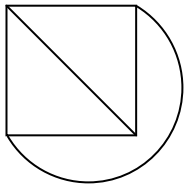
Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

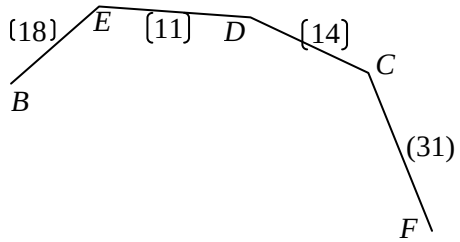
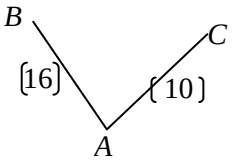
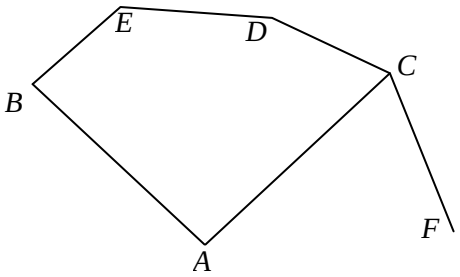
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

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

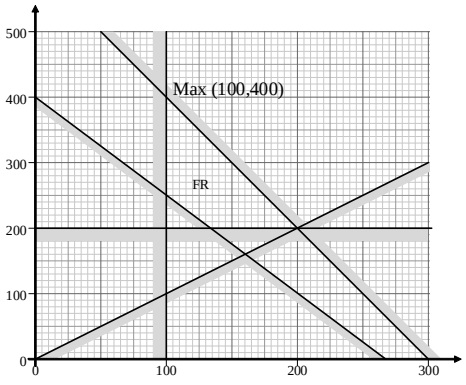
Q	Solution	Marks	Total	Comments
1(a)	$\begin{array}{c\|cccccc} & 1 & 2 & 3 & 4 & 5 & 6 \\ A & 0 & 0 & 1 & 0 & 0 & 0 \\ B & 1 & 0 & 0 & 1 & 0 & 0 \\ C & 0 & 0 & 1 & 0 & 0 & 1 \\ D & 1 & 1 & 0 & 0 & 0 & 0 \\ E & 0 & 0 & 0 & 1 & 1 & 0 \\ F & 0 & 0 & 0 & 0 & 1 & 1 \end{array}$	M1		6×6 matrix labelled with some 0, 1, ✓,✗'s (at least 9 entries)
		A1	2	All correct
(b)	$A-3+C$ or $2-D+1$	M1		
	$A-3+C-6+F-5+E-4+B-1+D-2$ or $2-D+1-B+4-E+5-F+6-C+3-A$	A1		
	Match $A3$, $B1$, $C6$, $D2$, $E4$, $F5$	B1	3	
	Total		**5**	
2(a)	1st 1 2nd 2 3rd 1	B2		All correct
		(B1)	2	2 correct
(b)	1st 1 2nd 2 3rd 0	B2		All correct
		(B1)	2	2 correct
(c)	No, has to check 23 (and 26)	E1	1	No, (at least) one more pass needed etc
	Total		**5**	

Q	Solution	Marks	Total	Comments
3(a)(i)	*AD* 4 *AB* 6 *AC* 16 *DE* 19 *EG* 10 *GI* 12 *IH* 13 *IF* 17	M1 B1 A1 A1	 4	Using Prims, first 3 edges correct, 6+ edges, no cycles, must have edges not lengths 8 edges *GI* 6th All correct
(ii)	97	B1	1	
(iii)		M1 A1	 2	ST with 6+ edges All correct including labels
(b)(i)	*IF*	B1	1	
(ii)	*AC*	B1	1	
	Total		**9**	
4(a)(i)		M1 A1 m1 A1 B1	 5	Dijkstra, 2+ values at *C* **and** 1 value at *B* and *D* Sight of 10, 9, 8 (only) at *C* 3 values at *E* **and** 2 values at *G* or *I* All correct, including crossing out, boxing (condone omission of 0 at *A*) 39 at *J* (final value)
(ii)	Route *A D C E F H I J*	B1	1	or reverse
(b)	(Time = 39 min) (Dist =) $\frac{their\,39}{60} \times 90$ OE = 58.5 km CAO	 M1 A1	 2	 Must see km, or 58500 m SC 58.5 with no working scores M1A0, but 58.5 km with no working scores 2/2
	Total		**8**	

Q	Solution	Marks	Total	Comments
5(a)	$BD+FH = \begin{matrix}210+210\\200+180\\260+340\end{matrix} = \begin{matrix}420\\380\\600\end{matrix}$	M1 A2,1		These 3 sets of pairs 3 correct totals, 2 correct totals
	(MIN) = 2430 + 380	m1		2430 + their smallest of three pair totals
	= 2810	A1	5	CSO
(b)	2430 + 340 (*DF*) = 2770	B1F	1	2430 + their *DF*
(c)(i)	2430 + 180 (*DH*) = 2610	B1F	1	2430 + their min (must have scored M1)
(ii)	*B, F* only	B1	1	
	Total		**8**	
6(a)		E1	1	
(b)(i)	28	B1		
(ii)	Odd number of edges at (all) vertices	E1	2	Must see the word odd, not just 7
(c)(i)	$\frac{n(n-1)}{2}$ OE	B1		
(ii)	$n-1$	B1		
(iii)	n must be odd	E1		Must have n in their answer
(iv)	$n = 3$	B1	4	Must have n in their answer
	Total		**7**	

Q	Solution	Marks	Total	Comments
7(a)	$\begin{pmatrix} A & C & F & D & E & B & A \\ & 10 & 31 & 32 & 11 & 18 & 16 \end{pmatrix}$			
	$= 118$	B1	1	
(b)	$A \quad C \quad D \quad E \quad B \quad F \quad A$ $(10 \quad 14 \quad 11 \quad 18 \quad 50 \quad 40)$	M1 m1 A1		Tour from A visiting at least 4 vertices Visits all vertices Correct order from A
	$= 143$	B1	4	
(c)		M1		Spanning tree + 2 different edges from A (ST must be edges using B, C, D, E, F not lengths, but condone two lengths from A, or 26) Diagram is not necessary in part (c)
		A1		Correct minimum spanning tree
	+ 	A1		Correct edges (not lengths) from A
	$= 100$	B1	4	
(d)		B1		Correctly labelled diagram
	Lower bound does not make a cycle OE AND tour > 100	E1	2	Both, must be strict inequality
	Total		**11**	

Q	Solution	Marks	Total	Comments
8(a)	*A* *B* *C* *D* 1 1 1 1 1 2 2 2.5 3 6 2.67 AWRT 4 24 2.71 AWRT	M1 A1 B1 m1 A1		At least 3 evaluated values for *D* 3rd value of *D* as 2.5 Values of (1), 1, 2, 6, 24 (only) seen for *C* Exactly 5 evaluated values for *D* Correct 5 values for *D*
	An estimate of e is 2.71 AWRT	A1 CSO	6	All correct values seen (1 for *A*, 4 for *B*, 5 for *C* and *D*) and correct final statement
(b)	Never-ending (loop) (*A*,) *B* (, *C*) always reset to 1 OE	B2,1	2	
	Total		**8**	

Q	Solution	Marks	Total	Comments
9(a)	$x \geq 100,\ y \geq 200$ $x + y + z \geq 400$ } OE	B1		
	$4x + 3y + 4z \leq 1800$ OE	B1		
	$y \geq \frac{40}{100}(x + y + z)$ OE	B1	3	
(b)(i)	$(x = 2z)$			
	$x + y + \frac{1}{2}x \geq 400$ $\Rightarrow 3x + 2y \geq 800$ }	M1		Correct substitution and fully simplifying 1 inequality (must see evidence: either replacing *z* or multiplying inequality)
	$4x + 3y + 2x \leq 1800$ $6x + 3y \leq 1800$ $2x + y \leq 600$ }	A1		As above 'in 2nd inequality'
	$5y \geq 2x + 2y + x$ $3y \geq 3x$ $y \geq x$ }	A1	3	As above 'in 3rd inequality'
(ii)				Each line must be straight to have the B mark available. For all lines, must be correct to half square horizontal and vertical at the indicated vertices.
		B1 B1 B1 B1 B1	5	$x = 100,\ y = 200$ $y = x$ line through (100, 100) and (200, 200) $2x + y = 600$ line through (100, 400) and (200, 200) $3x + 2y = 800$ line through (100, 250) and (200, 100) Feasible Region, all lines correct and region labelled (condone no shading, ignore 'poor' shading)
(iii)	(Max) $y + \frac{3}{2}x$	M1		PI by objective line with gradient –1.5
	$(= 400 + 150) = 550$	A1	2	
(iv)	Buys 100 soft 400 medium 50 firm	B1	1	
	Total		**14**	
	TOTAL		**75**	