Version 1.0



General Certificate of Education (A-level)
June 2011

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 candidates' 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 candidates' 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.

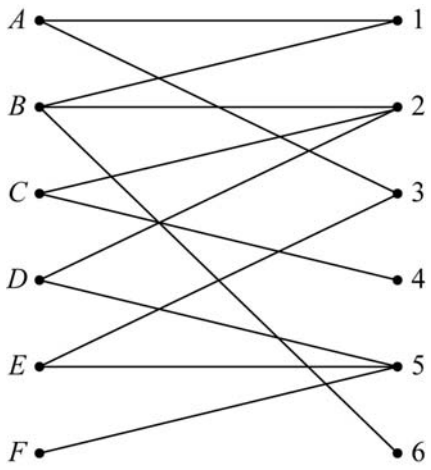
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn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

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

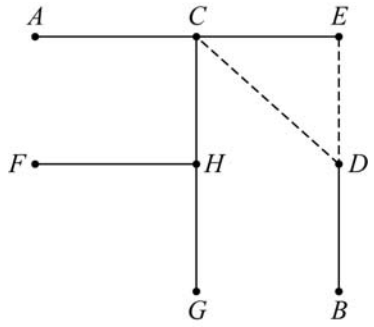
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

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

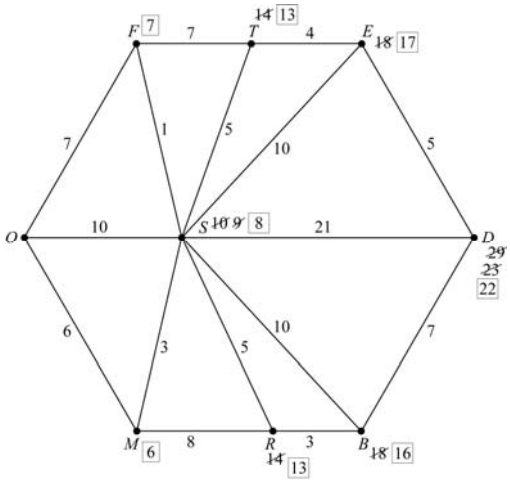
MD01

Q	Solution	Marks	Total	Comments
1(a)		M1		Bipartite graph, 2 sets of 6 vertices with 10+ edges
		A1	2	Correct including labelling
(b)	$E-5+D$ $E-3+A$ $F-5+D$ $F-5+E$	M1		1 correct
	$1-A+3$ $1-B+2$ $6-B+1$ $6-B+2$	M1		1 correct, from a different starting point
	$E-3+A-1$	A1		
	$F-5+D-2+B-6$	A1		Either order
	Match $A1$, $B6$, $C4$, $D2$, $E3$, $F5$	B1	5	Must be listed, not simply shown on diagram
	or first $E-5+D-2+B-1$	(A1)		
	then $F-5+E-3+A-1+B-6$	(A1)		Must be in this order
	or first $E-5+D-2+B-6$	(A1)		
	then $F-5+E-3+A-1$	(A1)		Must be in this order
	or first $F-5+D-2+B-1$	(A1)		
	then $E-3+A-1+B-6$	(A1)		Must be in this order
	Total		**7**	

MD01 (cont)

Q	Solution	Marks	Total	Comments
2(a)(i)	$x < 6$	B1	1	Condone $x \leq 5$
(ii)	$x < 4$	B1	1	$x \leq 3$
(b)(i)	$x < 11$	B1	1	$x \leq 10$
(ii)	$x > 2$	B1	1	$x \geq 3$ Condone $2 < x < 11$
(c)	$x = 3$	M1 A1	 2	Their max (b)(ii) < x < their min (a) CSO
	Total		**6**	
3(a)(i)	*AC* *CH* *FH* *CE* *CD* (or *ED*) *GH* *DB*	M1 B1 A1 A1	 4	Prim's, ST, 5+ edges (no cycles), edges not lengths or vertices, with first 4 edges correct 7 edges *CD* (or *ED*) 5th All correct
(ii)		 M1 A1	 2	*CD*, *ED* either of these lines ST with 5+ edges, connected, no cycles Correct, including labelling
(iii)	75(p)	B1	1	
(b)	Delete *CH*, *HG*, *HF* and add *FA* and one of *GC*, *GA*, *GD*, *GF* **or** a ST with 6 edges not including *H* (either as a list or a diagram) 70(p)	M1 A1	 2	Deleting their edges connected to *H*, and adding edges to make a ST with 6 edges Note: 70 scores 2/2
	Total		**9**	

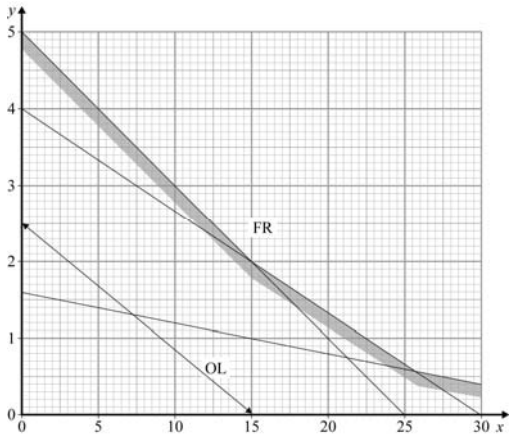
MD01 (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)		M1 A1 m1 m1 A1 B1	 6	2+ values at *S* or *R* or *T* Correct values at *S* 2 values at *E* and 2 values at *B* 3 values at *D* All correct, condone 0 missing at *A*, with rejected values crossed and final values boxed and no extra values at other vertices 22 is final value at *D* (value on diagram overrides value in script)
(ii)	Route *O F S T E D*	B1	1	Or reverse
(b)(i)	16	B1	1	
(ii)	*O F S R B*	B1	1	Or reverse
	Total		**9**	
5(a)	*AC* + *FD* (= 14 + 18) = 32	M1		These 3 correct sets of pairs, letters not numbers
	AF + *CD* (= 10 + 26) = 36	A2,1		3 correct totals, 2 correct totals
	AD + *CF* (= 26 + 24) = 50			Condone 26 + 24 not evaluated if statement of "too big" OE
	min = 150 + 32	m1		150 + their smallest, PI
	= 182	A1cso	5	
(b)	Repeat *FD*	M1		PI 182 – *AC*
	(= 150 + 18) = 168	A1	2	168 unsupported scores 2/2
(c)(i)	Repeat *AF*	M1		PI
	(= 150 + 10) = 160	A1	2	160 unsupported scores 2/2
(ii)	(Start/finish) *C* and *D*	B1	1	Must have both and only these
	Total		**10**	

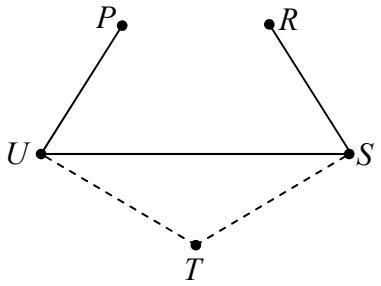
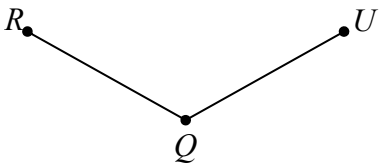
MD01 (cont)

Q	Solution	Marks	Total	Comments
6(a)	<table><tr><th>*A*</th><th>*B*</th><th>*C*</th><th>*D*</th><th>*E*</th></tr><tr><td>6</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td>7</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td>300</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td>6.5</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td>25.375</td></tr><tr><td>6.5</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td>6.75</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td>–7.547</td></tr><tr><td></td><td>6.75</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td>6.625</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td>9.22</td></tr><tr><td>6.625</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td>6.6875</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td>0.92</td></tr></table>	M1 A1 m1 A1	 4	Trace as far as 2 values for *D* and *E* Condone omission of 6, 7, 300 6.5 at *A*, 6.75 at *D* At least 4 values for *D* and *E* All correct including sight of 6, 7, 300, with AWRT correct to 3sf or better
(b)	1st reason: No output	E1		OE
	2nd reason: Need to know an interval within which the cube root lies at the outset	E2,1	3	OE For E2, must be a general statement For E1, a statement only referring to 6, 7 or 300
	Total		**7**	

MD01 (cont)

Q	Solution	Marks	Total	Comments
7(a)	$x+5y \geqslant 25$ OE	B1		ISW
	$2x+15y \geqslant 60$ OE	B1		ISW
	$x+25y \geqslant 40$ OE	B1		ISW
	$(C=)\ 2.5x+15y$	B1	4	ISW; condone $250x + 1500y$, but not any other multiples
(b)(i)				Note: all points need to be correct to within half a square horizontally and vertically
		B1		Line through (0, 5) and (25, 0)
		B1		Line through (0, 4) and (30, 0)
		B1		Line through (15, 1) and (30, 0.4)
		B1		FR, must have all lines correct and labelled region (condone no shading)
		M1		Objective line drawn, gradient of $-\frac{1}{6}$ or -6
		A1	6	Gradient $= -\frac{1}{6}$
(ii)	15 DIY, 2 trade	B1	1	
(iii)	(Cost) £67.50	B1	1	Condone 6750p, £67.5
	Total		**12**	

MD01 (cont)

<table>
<tr><th>Q</th><th>Solution</th><th>Marks</th><th>Total</th><th>Comments</th></tr>
<tr><td>8(a)(i)</td><td>P U S R (= 40)</td><td>E1</td><td></td><td></td></tr>
<tr><td></td><td>Less than any other route</td><td>E1</td><td>2</td><td>Or any one of PQR = 50, PUQR = 45, PUR = 44, PUTSR = 54 etc stated</td></tr>
<tr><td>(ii)</td><td>
<table>
<tr><th></th><th>P</th><th>Q</th><th>R</th><th>S</th><th>T</th><th>U</th></tr>
<tr><td>P</td><td>-</td><td>25</td><td>40</td><td>24</td><td>26</td><td>14</td></tr>
<tr><td>Q</td><td>25</td><td>-</td><td>20</td><td>21</td><td>23</td><td>11</td></tr>
<tr><td>R</td><td>40</td><td>20</td><td>-</td><td>16</td><td>28</td><td>26</td></tr>
<tr><td>S</td><td>24</td><td>21</td><td>16</td><td>-</td><td>12</td><td>10</td></tr>
<tr><td>T</td><td>26</td><td>23</td><td>28</td><td>12</td><td>-</td><td>12</td></tr>
<tr><td>U</td><td>14</td><td>11</td><td>26</td><td>10</td><td>12</td><td>-</td></tr>
</table>
</td><td>B1</td><td></td><td>6+ correct either above or below diagonal</td></tr>
<tr><td></td><td></td><td>B1</td><td>2</td><td>All correct</td></tr>
<tr><td>(b)(i)</td><td>Q U S T P R Q</td><td>M1</td><td></td><td>Tour visiting vertices once only (except start/finish vertex)</td></tr>
<tr><td></td><td></td><td>m1</td><td></td><td>Visits all vertices</td></tr>
<tr><td></td><td></td><td>A1</td><td></td><td>Correct order</td></tr>
<tr><td></td><td>= 119 (min)</td><td>B1</td><td>4</td><td></td></tr>
<tr><td>(ii)</td><td>Q U S T U P U S R Q</td><td>M1</td><td></td><td>Any “expansion” of TP or PR from their (b)(i), PI</td></tr>
<tr><td></td><td></td><td>A1</td><td>2</td><td></td></tr>
<tr><td>(c)</td><td>
</td><td>M1
A1</td><td></td><td>ST without Q (either drawn (vertices labelled) or edges listed)
and
2 different edges from Q (either drawn (vertices labelled) or edges listed)
either UT or TS in correct MST</td></tr>
<tr><td></td><td>
</td><td>B1
A1</td><td></td><td>4 edges in a labelled ST (must not include Q)
Correct 2 edges from Q</td></tr>
<tr><td></td><td>= 83</td><td>B1</td><td>5</td><td></td></tr>
<tr><td></td><td>Total</td><td></td><td>15</td><td></td></tr>
<tr><td></td><td>TOTAL</td><td></td><td>75</td><td></td></tr>
</table>