Version



General Certificate of Education (A-level)
January 2013

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

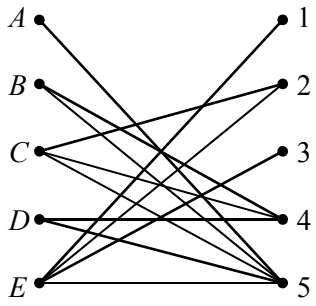
Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

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**.

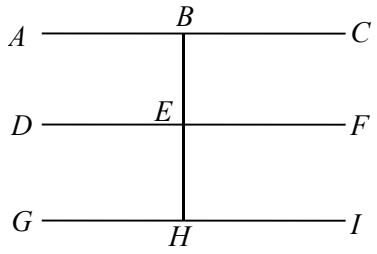
Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

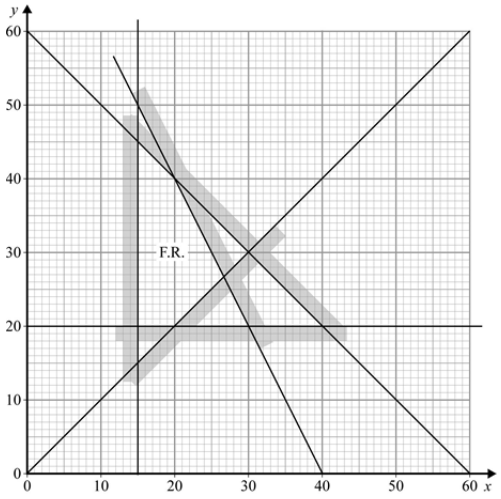
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

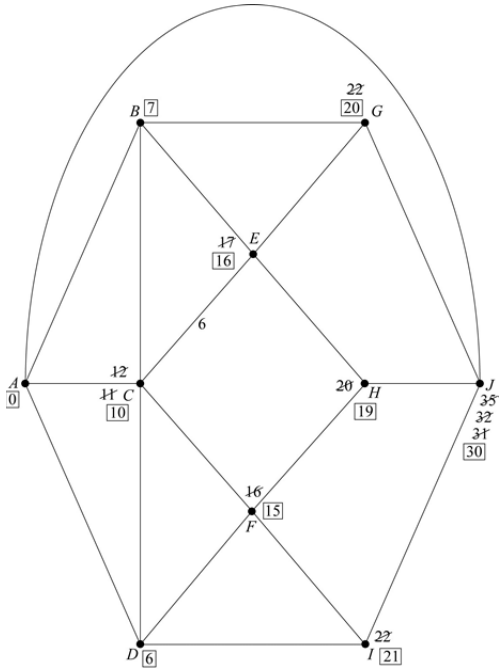
Otherwise we require evidence of a correct method for any marks to be awarded.

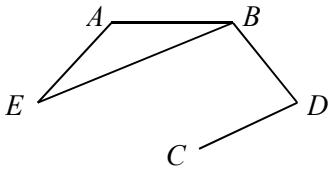
Q	Solution	Marks	Total	Comments
(1)(a)		M1 A1	 2	Bipartite graph, 2 sets of 5 vertices, at least 9 edges All correct, including labelling
(b)	Only *E* can do task 1 and task 3. One person cannot do 2 tasks so impossible. **Or** *A* does 5, then *B* must do task 4 and *D* must do task 4. One task cannot be done by 2 people so impossible. **Or** 4 people *A*, *B*, *C*, *D* can only do 3 tasks 2, 4, 5 Not enough tasks for the number of people so impossible.	M1 A1 (M1) (A1) (M1) (A1)	2	 Must have *A* to 5 first, or 3 people *A*, *B*, *D* can only do 2 tasks 4, 5 Not enough tasks for the number of people so impossible.
	Total		**4**	

Q	Solution	Marks	Total	Comments
2(a)	7 8 1 6 3 4 5 2 x – 0 ~ x – 0 ~ 7 3 8 4 1 5 6 2 3 4 1 2 7 8 5 6 – x – x – x – x 3 1 7 5 4 2 8 6 1 2 3 4 5 6 7 8 1 2 3 4 5 6 7 8	M1 A1 m1 A1	 4	4 sets of 2 with evidence of at least 1 pair being compared Must see this line 2 sets of 4 with evidence of at least 1 set being compared All correct, including third pass (ignore extra 'lines' of working)
(b)	4	B1	1	
	Total		**5**	
3(a)	(Odds *B,D,F,H)* *BD+FH* = 37.2 *BF+DH* = 38.4 *BH+DF* = 40 Length 118 + 37.2 = 155.2	 M1 A2,1 m1 A1	 5	 These 3 pairs of odds stated 3 correct totals, 2 correct totals 118 + their 'smallest' PI by their final answer CSO, including 3 correct totals.
(b)(i)	E twice	B1		
(ii)	*I* twice	B1	2	
	Total		**7**	

Q	Solution	Marks	Total	Comments
4(a)(i)	AB 6.1 BC 7.4 BE 9.7 DE 7.2 EF 10.6 EH 12.5 HI 6.7 GH 8.9	M1 B1 A1 A1		Prim's, 1st 3 correct, must be edges not lengths and no cycles 8 edges EF 5th All correct
(ii)	(Length =) 69.1	B1		
(iii)		M1 A1	 7	Spanning tree with 9 vertices and 8 edges All correct, including labelling
(b)(i)	GH	B1		
(ii)	EF	B1	2	
(c)(i)	1st AB	B1		
(ii)	Last EH	B1	2	
	Total		**11**	

Q	Solution	Marks	Total	Comments
5(a)		 B1 B1 B1 B1	 5	Accuracy: All lines must be ruled, correct to within ½ small square both horizontally and vertically $x = 15,\ y = 20$ $x + y = 60$, correct at (10, 50) and (40, 20) $2x + y = 80$, correct at (15, 50) and (30, 20) $y = x$, correct at (10, 10) and (30, 30) F.R. (a pentagon) labelled, must have scored previous 4 marks
(b)(i)	(Max at) (15,45)	B1		
	(P =) 195	B1	2	
(ii)	Sight of (26 – 27, 26 – 27)	B1		
	(P =) 130 - 135	M1		
	(P =) $\frac{400}{3}$	A1	3	oe
	Total		**10**	

Q	Solution	Marks	Total	Comments
6(a)		M1		Using Dijkstra, 2 or 3 values at *C* **and** one value **only** at both *B* and *D*
		A1		Correct values at *C*
		m1		2 values at *G, H, I*
		m1		4 values at *J*
		A1		All correct, including cancelling and boxing. (condone omission of 0 at *A*)
		B1		Final value at *J* is 30.
	Route *A B C F I J*	B1	7	Or reverse
(b)	From (a) $\frac{\text{'their'}30}{50}(\times 60) = 36$ (mins) (or 0.6 (hrs))	M1		Attempt at finding EITHER time (PI by answer)
	Direct $\frac{35}{60}(\times 60) = 35$ (mins) (or 0.58 AWRT (hrs))	A1F		Both correct (oe)
	Min time = 35 mins (or 0.583 hrs or 7/12 hrs)	B1	3	Must see units
	Total		**10**	
7(a)(i)	7	B1		
(ii)	28	B1	2	
(b)(i)	$n-1$	B1		
(ii)	$\frac{n(n-1)}{2}$	B1	2	oe,
(c)(i)	*(d =)* 0,1,2,3,4,5	B2		B1 for at least 0,1,5 or B1 for at least 2,3,4
(ii)	*(d =)* 2,3,4,5	B1		
(iii)	*(d =)* 2,4	B1	4	
	Total		**8**	

Q	Solution	Marks	Total	Comments
8(a)	58	B1	1	
(b)	$E\ A\ C\ D\ B\ E$	B1	1	Or reverse
(c)	$E\ \ A\ \ B\ \ D\ \ C\ \ E$ $(8\ \ 10\ \ 15\ \ 10\ \ 23)$	M1 m1 A1		Tour Visit all vertices Correct order
	$= 66$	A1 CSO	4	If M0 scored, then 66 scores SC2
(d)	$\begin{bmatrix} AB \\ BD \\ DC \end{bmatrix}$ (35)	M1		A spanning tree with 3 edges connecting *A, B, C* and *D* and 2 edges from *E*
		A1		Correct m s t
	$\begin{bmatrix} EA \\ EB \end{bmatrix}$ $(17\ \ =\ 52)$	A1		Correct edges from *E*
	52	A1 CSO	4	If M0 scored, then 52 scores SC2
(e)		B1		
	Doesn't give a tour	E1	2	Or other sensible conclusion Eg: tour > 52 or 'doesn't give a solution'
	Total		**12**	

Q	Solution	Marks	Total	Comments
9	$2x+3y+5z \le 400$ $3x+4y+3z \le 400$	B1		Both
	$(6x+2y+2z \le 400)$			
	$\Rightarrow 3x+y+z \le 200$	B1		
	$11x+9y+10z \ge 1000$	B1		
	their$(2x+3y+5z)$ > their$(3x+4y+3z)$	M1		Condone $\ge$
	$2z > x+y$	A1 CAO		oe
	$6x+2y+2z \le \frac{4}{10}(11x+9y+10z)$	M1		Condone $<$ Allow numerical values to $\frac{4}{10}$
	$16x-16y-20z \le 0$ oe	A1		
	$4x \le 4y+5z$	A1 CAO	8	
	Total		**8**	
	TOTAL		**75**	