Version 1.0: 0109

General Certificate of Education

Mathematics 6360

MD01 Decision 1

Mark Scheme

2009 examination - January 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.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX
Dr Michael Cresswell Director General

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	or equivalent	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)

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. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

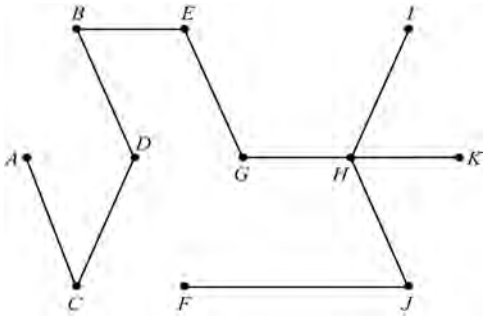
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn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

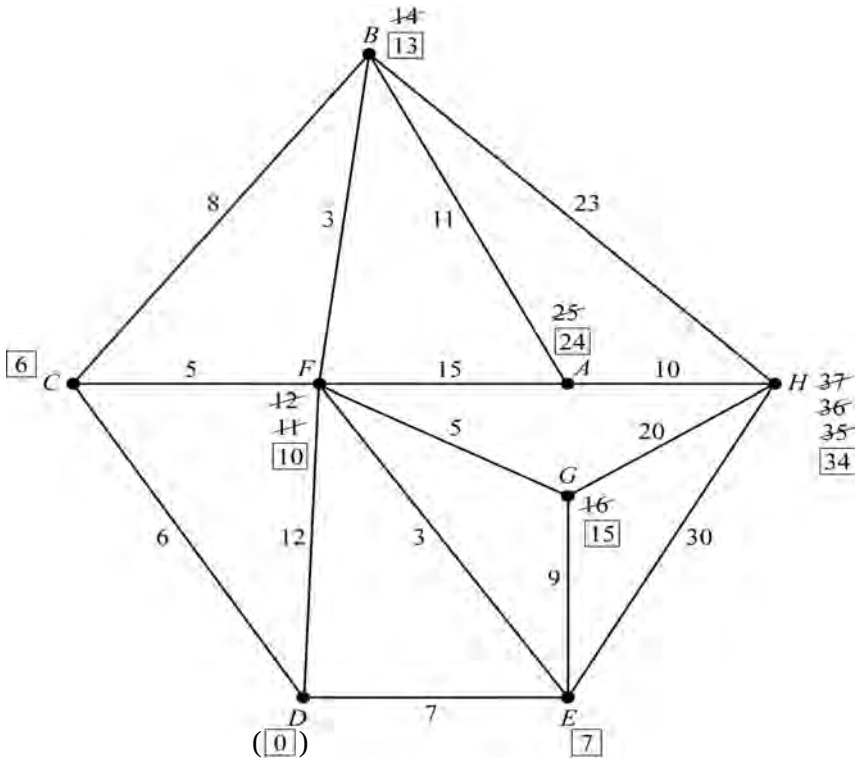
MD01

Q	Solution	Marks	Total	Comments
1(a)		M1		SCA allow Prim's from any vertex
	GH (5)			**but not** Kruskal or path – min of 8 edges
	GE (7)			
	HJ (8)	B1		10 edges
	BE (10)	A1		*HJ* 3rd
	BD (11)	A1		*BE* 4th
	IH (14)			
	DC (15)			
	AC (6)	A1		*AC* 8th
	FJ (19)			
	HK (22)	A1	6	All correct
(b)	117	B1	1	
(c)		M1		MST (8+ edges)
		A1		10 edges
		A1	3	All correct (+ vertices labelled)
	(Possibly shown in part (a))			
	Total		**10**	
2(a)	Labelled 6 × 6 matrix with '1's	M1		Must have '1's not '✓'s
				Or
				OE
		A1	2	Must have '0's not '–'s or blank
(b)		M1		$A-2+C$ or $3-B+1$
	$A-2+C-1+B-3$	A1		
		M1		$F-5+E$ or $6-D+4$
	$F-5+E-4+D-6$	A1		
	Match: *A*2, *C*1, *B*3, *F*5, *E*4, *D*6	B1	5	**If working on diagram**: Only one path on each half M1A1M1A1 as above **– start point must be shown, otherwise M0**
	Total		**7**	

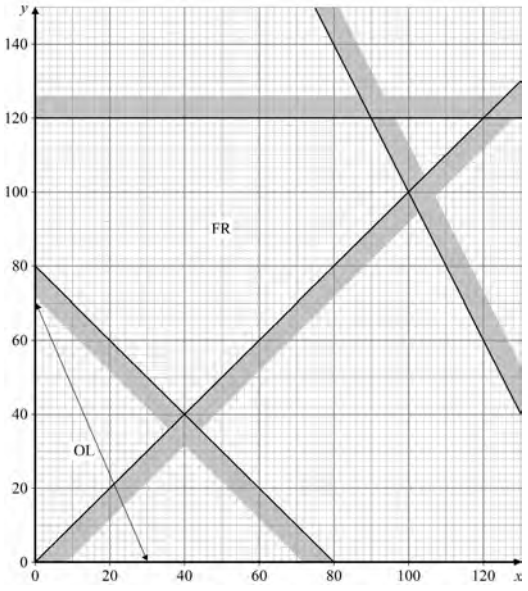
	1	2	3	4	5	6
A	0	1	0	0	0	0
B	1	1	1	0	0	0
C	1	1	0	0	0	0
D	0	0	0	1	0	1
E	0	0	0	1	1	0
F	0	0	0	0	1	0

	A	*B*	*C*	*D*	*E*	*F*
1	0	1	1	0	0	0
2	1	1	1	0	0	0
3	0	1	0	0	0	0
4	0	0	0	1	1	0
5	0	0	0	0	1	1
6	0	0	0	1	0	0

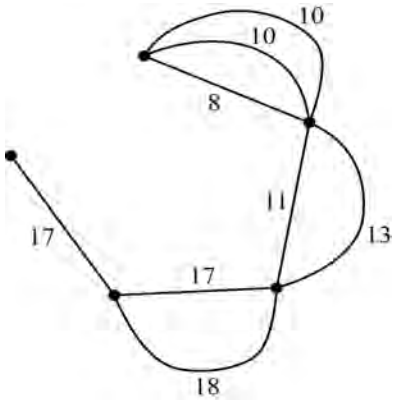
MD01 (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)				
		M1 A1 m1 A1 m1 A1	 6	Cancelling at at least 2 vertices Correct at *F* 2 different values at *B* Correct at *G* – depends only on M1 4 different values at *H* All correct – no extra values
	Alternative if working from *H*: $H\,\boxed{0}, A\,\boxed{10}, B\,\cancel{23}\,\boxed{21}, F\,\cancel{25}\,\boxed{24}, C\,\boxed{29},$ $D\,\cancel{36}\,(\cancel{35})\,\boxed{34}, G\,\boxed{20}, E\,\cancel{30}\,\cancel{29}\,\boxed{27}$	(M1) (A1) (m1) (A1) (m1) (A1)		SCA Correct at *B* 2 values at *F* Correct at *E* 2 or 3 values at *D* All correct
(ii)	Route: *DEFBAH*	B1	1	Or reverse
(b)(i)	24	B1	1	
(ii)	(Odds) *A*, *C*, *D*, *G* only *AC* + *DG* = 19 +15 or 34 *AD* + *CG* = 24 +10 or 34 *AG* + *CD* = 19 + 6 or **25** (Repeat *AG* + *CD*) Length = 25 + 167 = 192	E1 M1 A2,1,0 A1F B1	 6	PI 3 sets of pairs 167 + their shortest pairing
	Total		**14**	

MD01 (cont)

Q	Solution	Marks	Total	Comments
4(a)	$x + y + z \geq 110$	B1		–1 for strict inequalities (max) –1 for using *g*, *p*, *s* instead of *x*, *y*, *z* (max)
	$y \geq x$	B1		
	$y + z \leq 150$	B1		
	$16x + 8y + 24z \leq 3120$ ISW $(2x + y + 3z \leq 390)$	B1		
	$(P =)\ 70x + 30y + 50z$	B1	5	
(b)(i)	$z = 30$	M1		Justify by correctly substituting into at least one of their inequalities
	$x + y \geq 80$ (or $x + y + 30 \geq 110$) $(y \geq x)$ $y \leq 120$ (or $y + 30 \leq 150$) $2x + y \leq 300$ (or $2x + y + 90 \leq 390$ OE)	A1	2	Correctly substituting into all 3 inequalities
	$(P = 70x + 30y + 1500)$			AG
(ii)		B1		$y = 120$
		B1		$x + y = 80$
		B1		$y = x$, correct at (40, 40) and (100, 100)
		M1		$2x + y = 300$, –ve gradient with one correct point in the interval $80 \leq x \leq 120$
		A1		Correct at (100, 100) and (90, 120)
		B1		Correct region labelled
		M1		OL: gradient of $-\frac{7}{3}$ or $-\frac{3}{7}$
		A1	8	Gradient = $-\frac{7}{3}$
(iii)	Considering (90, 120) and/or (100, 100)	M1		Ignore other points being considered
	(£) 11500	A1		
	100 goats, 100 pigs, 30 sheep	A1	3	CAO
	Total		**18**	

MD01 (cont)

Q	Solution	Marks	Total	Comments
5	*A* *B* *C* *D* *E* *F* *G* *H* 1 3 0 1 2 0 1.5 2.25 7 3 7 5 2 5 1.4 1.96 17 7 17 12 5 12 1.41$\dot{6}$ 2.007 $\left(\sqrt{2} \text{ is approximately } \frac{17}{12}\right)$	M1 A1 M1 A1 M1 A1	6	Condone equivalent fractions SCA – finding a value for *G* 1st pass *G*, *H* correct 2nd pass – finding a new value for *C* All correct on pass 3rd pass *C* = 17 or their (2*B*+*A*) AWRT 1.417 All correct (allow 2.005 to 2.008) and no further passes
	Total		**6**	
6(a)	Min MST = 8 + 10 +10 + 11 = 39	M1 A1	2	4 edges
(b)	Max MST = 8 + 17 +17 +18 = 60	M1 A1	2	8 + 18 + 2 others
(c)		M1 A1 A1	3	Connected graph with 5 vertices (all edges numbered, from *G*) MST = 53 8, 11, 17, 17 or 8, 10, 17, 18 other edges OE (other possibilities not shown) (all edges numbered, from *G*)
	Total		**7**	

MD01 (cont)

Q	Solution	Marks	Total	Comments
7(a)(i)	$2x-4<x+6$	M1		$2x-4<$
	$\therefore x<10$ CSO	A1	2	AG
(ii)	$2x-4<3x-7$ OE	B1		Allow any expression in matrix > 0
	$2x-4<4x-14$ OE	B1	2	Allow any expression in matrix > 0
	$\begin{pmatrix} =x>3 \\ x>5 \end{pmatrix}$			
(b)(i)	$2x-1<$	M1		Condone $\leq$ for method mark only
	$2x-1<3x-7$	A1		
	$2x-1<x+8$	A1	3	
(ii)	$\Rightarrow (x>6)$			
	$x<9$	B1		Possibly earned in (b)(i)
	$2x-2<3x-9$	M1		Condone $\leq$ for method mark only
	$x>7$	A1		
	$x=8$	B1	4	
(iii)	$A \quad C \quad D \quad E \quad B \quad A$			
	12 15 14 17 14	M1		$8x+8$ with their integer x
	= 72	A1	2	CAO (unsupported 72 scores M0A0)
	Total		**13**	
	TOTAL		**75**	