AQA

AS
Mathematics

MD01 Decision 1
Final Mark scheme

6360
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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	Mark	Total	Comment
1 (a)	**EITHER** Path starting $D-3+E$ or $4-E+3$ or $C-2+B$ or $6-A+1$	**M1**		Paths should be listed, but allow on diagram provided one path per diagram and start/end clearly labelled
	$D-3+E-4$	**A1**		Or reverse
	$C-2+B-1+A-6$	**A1**		Or reverse
	Matching $A6$, $B1$, $C2$, $D3$, $E4$, $F5$	**B1**		Must be listed
	OR Path starting $6-F+5$ or $D-3+E$	**(M1)**		
	$6-F+5-E+3-D$ followed by $4-E+5-F+6-A+1-B+2-C$	**(A1)** **(A1)**		Or reverse Or reverse
	Matching $A6$, $B1$, $C2$, $D3$, $E4$, $F5$	**(B1)**	**4**	
(b)	As A wants to play 1, B must play 2	**E1**		OE
	C cannot now play 2 so full team is impossible.	**E1dep**		Or complete match is impossible
	OR As A wants to play 1, F must play 6	**(E1)**		
	So E must play 5 So no-one to play 4 so full team is impossible.	**(E1dep)**	**2**	
	Total		**6**	

Notes:

In part (a) allow different notations, e.g. C2B1A6 or $C-2+B-1$ or $C-2+B-1+1+A-6$ or $C-2+B-1+A-6$

i.e. any notation which preserves the idea of a continuous path, including different symbols

In part (b) the first mark is for a first (simple) consequence and the second is for a full explanation, which must include "full team impossible" (or complete matching impossible)

Cannot score 2nd E mark unless first E mark scored

Q	Solution	Mark	Total	Comment
2 (a)	(*A, C, E, G* odd vertices)			
	AC + *EG* (= 10 + 10) = 20 *AE* + *CG* (= 12 + 14) = 26 *AG* + *CE* (= 13 + 12) = 25	**M1**		These 3 pairs and added
		A2,1,0		-1 per error in final totals
	Route = 110 + 20	**dM1**		PI 110 + lowest of their 3 totals
	= 130 (m)	**A1**		CSO Must have scored the first 4 marks.
			5	
(b)	3	**B1**	**1**	This answer might be in question script but answer space takes precedence.
	Total		**6**	

Notes:

(a) For any answer other than 130 the m/s applies exactly

For an answer of 130, this scores:

5/5 for NO errors/omissions

4/5 IMPOSSIBLE

3/5 for ONE error/omission

2/5 for TWO or more errors/omissions

eg

candidate has the correct 3 pairs, gives 3 totals, with one incorrect followed by an answer of 130 scores 3/5

candidate has the correct 3 pairs, gives 3 totals, with two incorrect followed by an answer of 130 scores 2/5

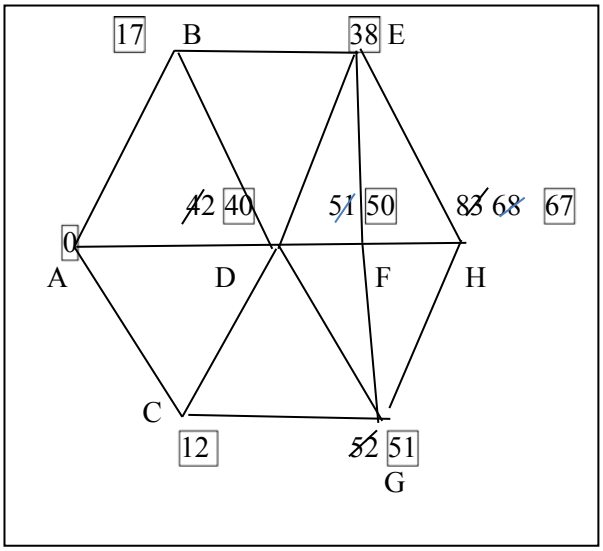
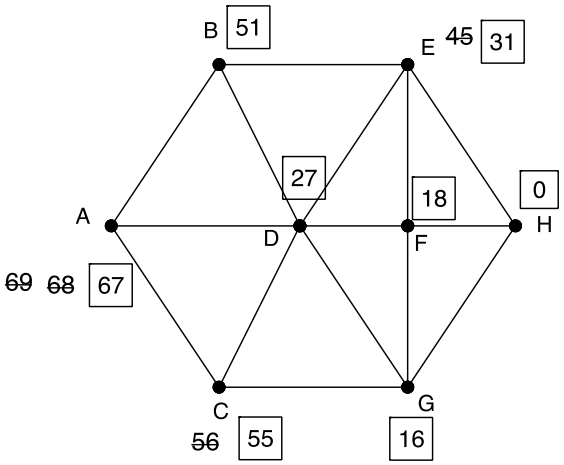
candidate has the correct 3 pairs, list the values but **does not give any totals** but merely an answer of 130 scores 3/5 – **SC**

candidate gives an answer of 130 with no working (or a route shown) scores 2/5 **SC**

Q	Solution	Mark	Total	Comment
3 (a)	18 3 45 17 1 26 43 22 16			
	18 1 16 3 26 45 43 17 22	**M1**		SCA: use of these 4 sub lists (which may be written down already sorted)
	1 3 43 17 16 26 45 22 18	**A1**		This line must be seen
	1 43 16 45 18 3 17 26 22	**dM1**		Correct use of 2 sub lists (which may be written down already sorted)
	1 3 16 17 18 22 43 26 45	**A1**		Must see 'merged' list
	1 3 16 17 18 22 26 43 45	**A1**	**5**	All correct
(b)	6	**B1**	**1**	This answer might be in question but answer space takes precedence.
	Total		**6**	

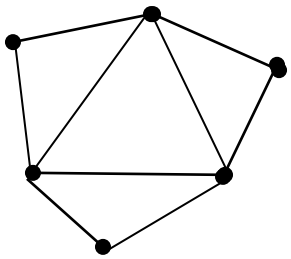
Notes:

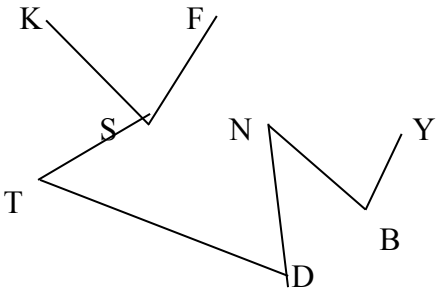
(a) The accuracy marks can imply the method marks
dM1 can be earned for a candidate who has scored **M1** but **A0**
Ignore any 'shuttle' interim sorts seen
If a candidate sorts the numbers into descending order then only the **M** marks are available

Q	Solution	Mark	Total	Comment
4 (a)(i)		**M1**		SCA 2 values at *D*, only 1 value at *B*, *C*
		A1		Correct values at *E, F, G*
		A1		All correct including crossing through, boxing. Condone missing/unboxed 0 at *A*.
		B1		67 final value at *H*
				If working in reverse
	(**M1**) SCA 2 values at E, 1 at F, G **(A1)** correct values at B, C, D **(A1)** all correct as above **(B1)** 67 at *A*			
(ii)	*ACDGH*	**B1**	**5**	Or reverse
(b)	*ABDGH*	**B1**		Or reverse
	68 (km)	**B1**	**2**	
	Total		**7**	

Notes:

(a) Candidates might use different notation eg '3-box method', crossing out required for 2nd **A** mark

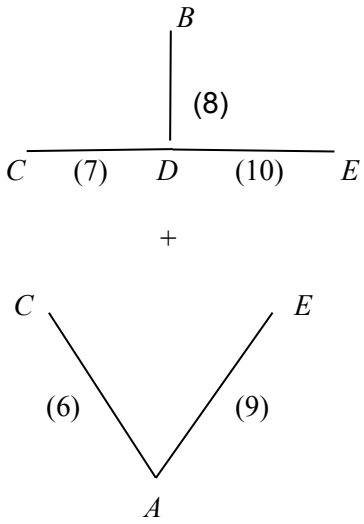
Q	Solution	Mark	Total	Comment
5 (a)	26 (cm)	**B1**	**1**	
(b)	Minimum spanning tree = 25 (3, 4, 4, 5, 9 or 3, 4, 5, 5, 8) Seen on a diagram not just as a list	**B1**		Edges throughout need not be straight.
	A connected graph with 6 vertices and 9 edges, labelled with the 9 values given	**M1**		
	Graph is simple	**A1**	**3**	
(c)	e.g. 	**M1**		Simple, connected graph with 6 vertices and 9 edges
		A1	**2**	Vertices of order 4, 4, 4, 2, 2, 2
	Total		**6**	
Notes:				

Q	Solution	Mark	Total	Comment
6 (a)(i)	*YB* *DN* *KS* *SF* *NB* *DT* *ST*	**M1** **A1** **B1**		SCA first 2 edges correct Allow *BY* for *YB* etc Correct as far as *SF* 7 edges, not values PI by spanning tree
		A1		Completely correct
(ii)	117 (miles)	**B1**		This answer might be in question script but answer space takes precedence.
(iii)		**B1**	**6**	All correct including labelling. Diagram must be shown separately not just highlighted over diagram in question on script.
(b)(i)	*BY*	**B1**		Accept *YB*
(ii)	*SF*	**B1**	**2**	Accept *FS* This answer might be in question script but answer space takes precedence.
	Total		**8**	

Notes:

(a) The three parts may be in any order
You must be convinced that the order of the edges given is clear eg list with edges on 2/3 lines

(b) Must be an edge not a vertex

Q	Solution	Mark	Total	Comment
7 (a)	50 (miles) Any **tour** is an upper bound OE	B1 E1	2	
(b)(i)	*C*....*C* *CAEDBC* 48 (miles)	M1 A1 B1		A tour including all 5 vertices (once only) starting from *C*
(ii)	*AEDBCA*	A1F	4	Or reverse If **M0** scored, a correct tour from *A* of the same length as **(b)(i)** scores **SC1**
(c)		M1 A1 A1		Any ST, not including *A,* plus 2 edges from *A,* indicated in diagram, writing or table, by edges and/or values Correct tree, with correct edges (not values) stated or in labelled diagram (not table) Correct edges from A, with correct edges (not values) stated or in labelled diagram (not table)
	((7 + 8 + 10) + (6 + 9) =) 40 (miles)	B1	4	
(d)	*'their'* 40 (miles) < *L* ≤ *48* (condone *x*, *T* etc for *L*)	B2F	2	Ft only if LB≤ UB Ft UB = their lower of (a) and (b) If 0 scored then **SC1** for either part of **complete** inequality correct (ft) as above Or answer written as 2 correct (ft) but separate inequalities scores **SC1** Only one inequality given, scores 0/2
	Total		**12**	

Notes: (a) OE, allow 'hamiltonian' or description in words visiting all vertices, returning to start. **But not 'it'**
(b)(i) A candidate 'working' on the table:
M1 for 5 values circled, one per row/column, with *C* numbered as 0 or 1
A1 for vertices correctly numbered with *C* labelled as 5 or 6
(d) condone 40 ≤ L≤ 48 for **B2**. Do **not** condone *L* < 48
If a candidate has written two separate inequalities, one of which is incorrect (ft), then this scores 0/2

Q	Solution	Mark	Total	Comment
8 (a)				

N	*A*	*B*	*C*	*D*
(6)	(1)	3	0.4286	0.5714
5	0.4286	2.0787	0.2970	0.1316
4	0.2970	2.0262	0.2895	0.0075
3	0.2895	2.0243	0.2892	0.0003
2				

M1 Trace as far as $N = 4$, condone exact fractions or working to other than 4 dp.

A1 Correct to $A = 0.2970$, **values as shown in the table**

A1 Correct to $N = 2$ and stopped, **values as shown in the table**

('C') <u>0.2892</u>

B1 **4** Correct *C* **'printed'** ie must appear in addition to final value in *C*–column

(b)

For parts (b) and (c) condone exact fractions or working to at least 3 dp

N	*A*	*B*	*C*	*D*
(6)	(0)	2	0.2857	-0.2857
5				

B1 Correct trace as far as $N = 5$ and stopping

B1 Correct *C* 'printed' (as above)

2

(c)(i)

(C) <u>0.2857</u> AWRT (or 2/7)

Replace $D < 0.001$? with $-0.001 < D < 0.001$? OE

B1 eg $D = |A - C|$, $|D| < 0.001$

(ii)

N	*A*	*B*	*C*	*D*
(6)	(0)	2	0.2857	(-)0.2857
5	0.2857	2.0233	0.2890	(-)0.0033
4	0.2890	2.0241	0.2892	(-)0.0002
3				

M1 Correct trace to 2nd value of *D* with signs consistent with their 'change step'

(C) <u>0.2892</u>

A1 Correct to $N = 3$ and stopped, including correct *C* 'printed' (as above)

3

	Total		**9**	

Notes:

(a) At least 2 values for N, and at least 2 values for each of B, C and D. Condone correct answers given in standard form

(b) Condone 0.286 as printed value

(c) Only accept 0.2892 as printed value
If a candidate has used exact fractions, or working to more than 4dp, their correct final value of D is 0.0001

Alternative to (c)

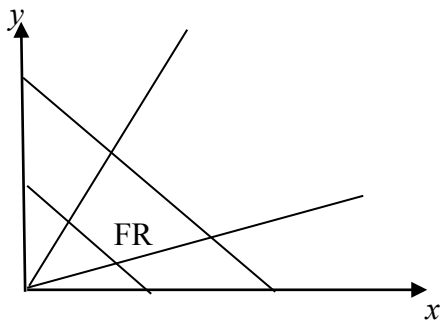
Replace '$D < 0.001$?' with '$D = 0$ to 4dp ?' **B1**

N	*A*	*B*	*C*	*D*
(6)	(0)	2	0.2857	–0.2857
5	0.2857	2.0233	0.2890	–0.0033
4	0.2890	2.0241	0.2892	–0.0002
3	0.2892	2.0242	0.2892	0.0000
2				

('C') <u>0.2892</u>

Correct trace to 2nd value of D **M1**

Correct to $N = 2$ and stopped, including correct C 'printed' (as before) **A1**

Q	Solution	Mark	Total	Comment
9 (a)	$x + y + z \geq 225$ $\quad x + y + z \leq 375$ $y \geq \frac{1}{2}x$ $\quad y \leq 3x$	B2	2	OE OE
(b)	$z = (x + y + z) \div 5$ PI $\Rightarrow \quad 4z = x + y$ PI	M1 A1		OE eg $x + y = 0.8(x + y + z)$ OE simplified to 3 terms
	$x + y + (x + y)/4 \geq 225$ (≤ 375)	M1		Correctly substitute for their z (must be in terms of x and y) in at least one of their 1st two inequalities in part (a)
	eg $\quad 5x + 5y \geq 900$ (≤ 1500)			Must see a middle step
	$x + y \geq 180$ $\quad x + y \leq 300$ **AG**	A1	4	CSO to produce given answers
(c)		B2 B1	3	All lines must be ruled, correct to within ½ square horizontally AND vertically All 4 lines correct $x + y = 180$ $\quad x + y = 300$, through intercepts 180 & 300 $y = \frac{1}{2}x$, $y = 3x$ through origin & (200, 100) and (100, 300) respectively **B1** for 2 correct lines All correct and FR labelled
(d)(i)	$(C) = 10x + 20y + 40z$ PI $= 10x + 20y + 40(x + y) \div 4$ $= 20x + 30y$	M1 A1		
	OL with gradient -2/3 (correct by eye)	B1F		Ft their expression for C
(ii)	(120, 60) stated (and identified as min) (Cost =) £4200 120 Economy, 60 Standard, 45 Deluxe	B1F B1 B1	6	See below Including units
	Total		15	

Notes (a) **B1** for any two inequalities correct

(b) For 1st method mark, allow 20/100 but not 20%. If a candidate has used inequality for z, then max mark is **M0A0M1A0**

Candidate **only** finding 80% of 225 (or 20%) scores 0

(d)(ii) For the **B1F**, using their OL on their FR(must be a quadrilateral), and stating the co-ordinates of the point that gives 'their' correct minimum. Correct by eye from graph.

If a candidate lists their extreme points, then the **B1F** is earned by correctly identifying their 'minimum'

Must see 'economy', 'standard' and 'deluxe' for final **B** mark