AQA

A-LEVEL
Mathematics

Decision 1 – MD01
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**.

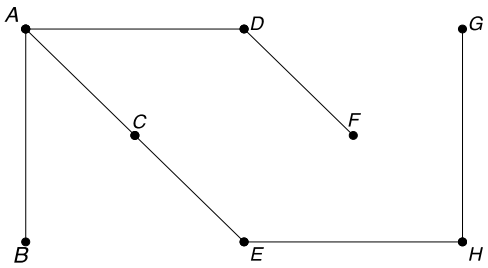
Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

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.

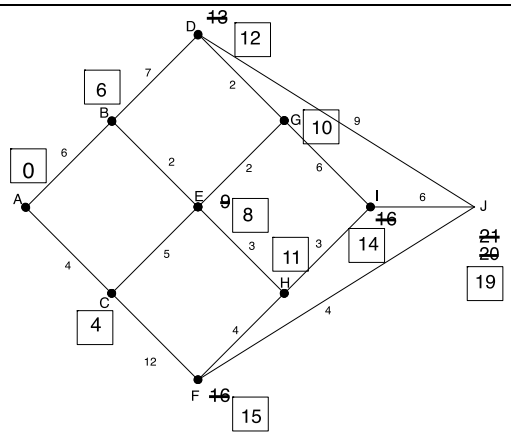
Q1	Solution	Mark	Total	Comment
1	**I**			
	Path starting *D*-2+*A* or 5-*A*+2	**M1**		Paths should be listed, but allow on
	Path starting *E*-3+*B* or 6-*F*+4	**M1**		diagram provided one path per diagram and start/end clearly labelled.
	D-2+*A*-5	**A1**		Or reverse
	E-3+*B*-4+*F*-6	**A1**		Or reverse
	Or			
	II			
	Path starting *D*-2+*A* or 6-*F*+4 followed by	**(M1)**		
	Path starting *E*-3+*C* or 5-*A*+1	**(M1)**		
	D-2+*A*-1+*C*-3+*B*-4+*F*-6 followed by	**(A1)**		Or reverse
	E-3+*C*-1+*A*-5	**(A1)**		Or reverse
	Or			
	III			
	Path starting *E*-3+*B* or 5-*A*+2 followed by	**(M1)**		
	Path starting *D*-2+*B* or 6-*F*+4	**(M1)**		
	E-3+*B*-2+*A*-5 followed by	**(A1)**		Or reverse
	D-2+*B*-4+*F*-6	**(A1)**		Or reverse
	Matching *A*5, *B*4, *C*1, *D*2, *E*3, *F*6	**B1**		Must be listed, not on a diagram
	Total		**5**	

Notes:
For **II and III** the paths MUST be in the order stated. If order is reversed then the max mark is M0A0M1A1
Watch for alternative, but correct, notation (needs to be clear).
If using a diagram, two paths indicated on one diagram will score M0.
Use of one long path, usually by attempting to combine two shorter ones, can earn a max of M1 A0 M0.

Q2	Solution	Mark	Total	Comment
2 (a) (i)	*AC* *AD* *CE* *EH* *HG* *AB* *DF*	**M1** **B1** **A1** **A1**	**4**	Use of Prim's, first three edges (not numbers) correct 7 different edges Correct up to and including *AB* 6th All correct
(ii)		**M1** **A1**	**2**	Spanning tree, no cycles, 8 vertices, 7 edges Correct, including labels but ignore any lengths
(iii)	£1170	**B1**	**1**	Must include units.
(b)	Replace *CE* with *DG* New cost £1200 or (value of their "£1170" + £30)	**M1** **A1F**	**2**	PI Must include units.
	Total		**9**	

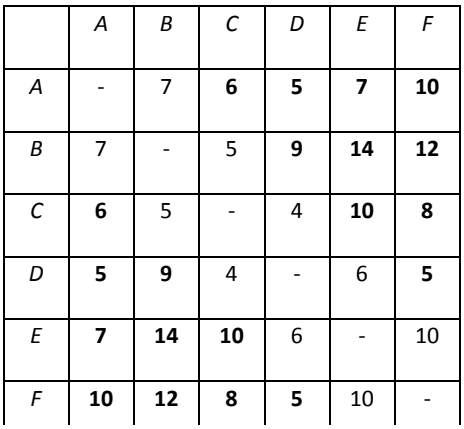
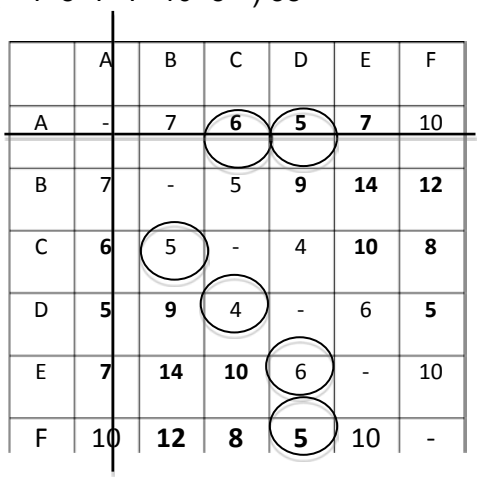
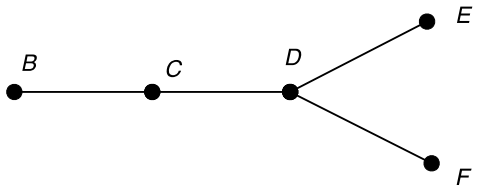
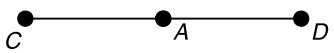
Notes:
For a(i), accept a diagram with the order of selection of edges clearly indicated.
For (a)(iii) and (b) penalise omission of units in the first instance only.

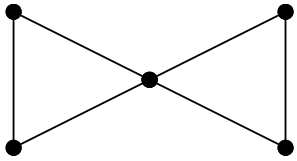
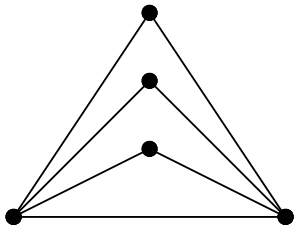
Q3	Solution	Mark	Total	Comment
3a	15	**B1**	**1**	
b	8	**B1**	**1**	
c	1	**B1**	**1**	
d	$\frac{n(n-1)}{2}$ with n = 16 Or $\frac{n(n+1)}{2}$ with n = 15 or 15 + 14 + ….+ 1	**M1**		PI (clear attempt to sum 1st 15 integers)
	120	**A1**	**2**	NMS 120 scores 2/2
	Total		**5**	

Q4	Solution	Mark	Total	Comment
4 (a) (i)		**M1** **A1** **m1** **A1** **B1**	**5**	Use of Dijkstra; two values at *E* and one at each of *G* and *H* Correct values only at *E* 2 values at each of *D*, *F* and *I*. Completely correct including all crossing out and boxing 19 at *J*. If stated in text as well, diagram takes precedence.
(ii)	Route *ABEHFJ* or reverse	**B1**	**1**	Must be listed, not just marked on diagram.
(b)	12 + 19 + 3 (= 34)	**M1**		Their final values for *AD* and *AJ* + 3
	11.04 (a.m.)	**A1F**	**2**	11.04 unsupported scores 2/2
	Total		**8**	

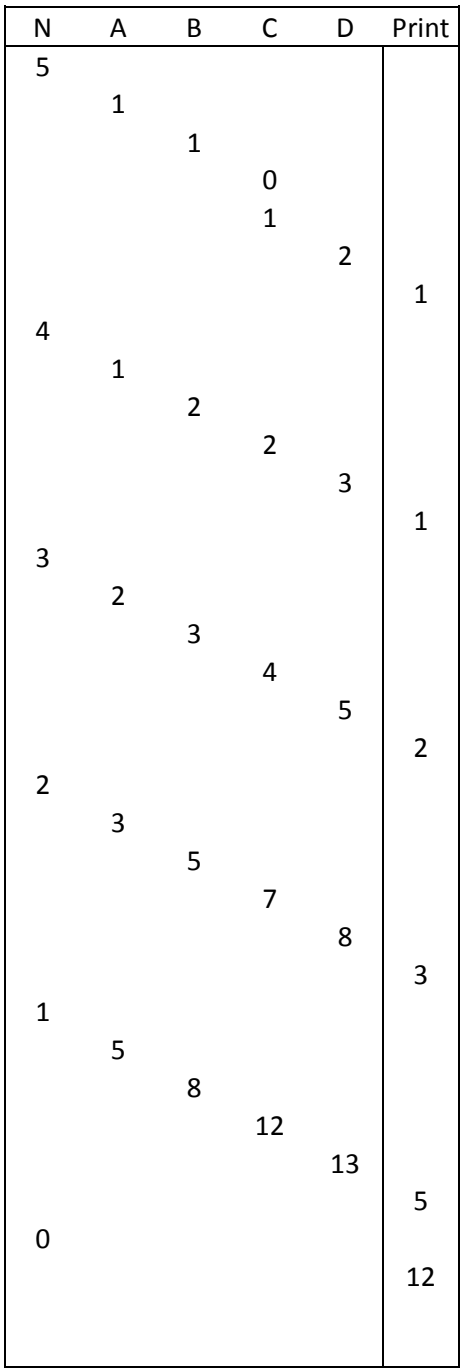
Q5	Solution	Mark	Total	Comment
5 (a)	*AB*+*CG* = (50 + 240) = 290 *AC*+*BG* = (100 + 230) = 330 *AG*+*BC* = (210 + 70) = 280 Solution = 1400 + their min total = 1680 m	**M1** **A2,1** **m1** **A1**	**5**	These 3 pairs stated including the intention to add 3 correct totals, 2 correct totals Of three totals PI CSO Must include units
(b)(i)	3	**B1**		
(ii)	3	**B1**	**2**	
	Total		**7**	

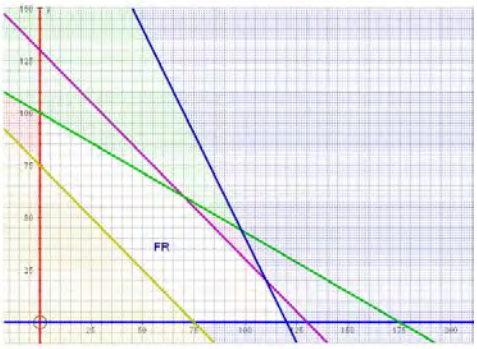
Notes:
For 5(a), SC if M0 scored then 1680 m scores 2/5. Must include units.
For 5(a), SC if M0 scored then 1680 scores 1/5 (no units)

Q	Solution	Mark	Total	Comment
6 (a)		B2,1,0	2	- 1 each independent error
(b) (i)	(7+10+12+5+4+5 =) 43	B1	1	
(ii)	It is a Hamiltonian cycle	E1	1	A possible solution to the problem, OE
(c)	DCBAEFD	M1		Hamiltonian cycle from D
		A1		Correct order
	(= 4+5+7+7+10+5 =) 38	B1	3	Correct length
(d)		M1		6 different edges, not just numbers, of which exactly 2 are from A (seen in diagram, listed or in table)
		A1		Correct MST (seen in diagram, listed or in table)
	 MST BC, CD, DE, DF Edges from A: AC, AD	A1		Correct edges from A (listed, in table or seen in diagram and clearly identified)
	(5+4+6+5)+(6+5) = 31	B1	4	
(e)	$31 < T \leq 38$	B1F	1	Their "31" < T ≤ their best of 2 ub provided lb ≤ ub Condone their "31" ≤ T ≤ their "38"
	Total		12	

Q7	Solution	Mark	Total	Comment
7 **(a)**	(m =) 4 or 5	**B1**		Either value, with no incorrect values, Or both correct and ONE other value.
		B1	**2**	Both values correct and no others
(b)	(n =) 3, 4, 5 or 6	**B1**		Three correct values and no incorrect values or all four correct with at most one extra value
		B1	**2**	All correct with no extra values
(c)				
		**B1**		Graph is simple and connected, and has 5 vertices, each with even degree.
		B1	**2**	Graph is isomorphic to one of the two shown.
	Total		**6**	

Notes: (a) An answer of 3, 4, 5, 6 scores B0 as 2 correct and 2 incorrect answers.

Q8	Solution	Mark	Total	Comment
8 (a)				**For all marks:** for each column/variable, condone 0s at the beginning of sequences and any repeated values
		M1		For N: sequence "5,4,3"
		A1		For N: sequence "5,4,3,2,1,0"
		A1		For B: sequence "1,2,3,5,8" **and** for D: sequence "2,3,5,8,13"
		B1		All prints seen and correct
		A1	**5**	Complete correct solution including all prints seen
(b)	*N* is used as a stopping condition	**E1**	**1**	OE but not simply "a counter"
	Total		**6**	

Q9	Solution	Mark	Total	Comment
9 (a)	$400x+400y+600z\le 130000$ $(2x+2y+3z\le 650)$	B1		OE
	$200x+500y+200z\le 70000$ $(2x+5y+2z\le 700)$	B1		OE
	$400x+100y+200z\le 72000$ $(4x+y+2z\le 720)$	B1		OE
	$z\ge 75$	B1	4	OE but z terms must be collected
(b)	Substitute $z = x + y$			
	$2x+2y+3z\le 650 \Rightarrow 5x+5y\le 650$ $\Rightarrow x+y\le 130$	M1		Clear substitution of $z = x + y$ into one of the first three inequalities
	$2x+5y+2z\le 700 \Rightarrow 4x+7y\le 700$			
	$4x+y+2z\le 720 \Rightarrow 6x+3y\le 720$ $\Rightarrow 2x+y\le 240$			
	$z\ge 75 \Rightarrow x+y\ge 75$	A1	2	All correct. AG. (with middle line in 1st and 3rd inequalities)
(c)				All points correct to within ±½ a small square vertically **and** horizontally and lines ruled
		B1		Line through (130,0) and (0,130)
		B1		Line through (175,0) and (0,100)
		B1		Line through (120,0) and (80,80)
		B1		Line through (75,0) and (0,75)
		B1	5	Feasible region correct and labelled, dep. on first B4
(d)	(P =) $50x + 100y + 150z$	M1		PI or seen
	(P =) $200x + 250y$	A1	2	ISW
(e) (i)	Either OL drawn with gradient -0.8	M1		Condone gradient of $-\frac{a}{b}$ or $-\frac{b}{a}$ from their **final** answer for part (d) $ax+by$
	$x = 70, y = 60$	A1 CSO		Dependent on gradient of -0.8
	or (0, 100) P = £25000 (70, 60) P = £29000 (110, 20) P = £27000 (120, 0) P = £24000 so max at $x = 70, y = 60$	(M1) (A1 CSO)	2	SCA Attempt to identify and **list** at least the four relevant vertices (OE from **their** hexagon) and attempt at finding some values of P. Must be clearly chosen from these four correct values
(ii)	P = £29000	B1		Including £
	70 tonnes Basic, 60 (tonnes) Premium, 130 (tonnes) Supreme	B1	2	All three correct, including units. (Not just $x = 70$, $y = 60$ and $z = 130$.)
	Total		17	