

A-LEVEL

Mathematics

Decision 1 – MD01
Mark scheme

6360
June 2015

Version/Stage: Version 1.0 : Final

Mark schemes are prepared by the Lead Assessment Writer 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 associates 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 associate understands and applies it in the same correct way. As preparation for standardisation each associate 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, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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.

Further copies of this Mark Scheme are available from aqa.org.uk

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 $5-A+2$ Path starting $E-3+B$ or $6-F+4$	M1 M1		Paths should be listed, but allow on diagram provided one path per diagram and start/end clearly labelled. Or reverse Or reverse Or reverse Or reverse Or reverse Or reverse Must be listed, not on a diagram
	$D-2+A-5$ $E-3+B-4+F-6$	A1 A1		
	Or			
	II Path starting $D-2+A$ or $6-F+4$ followed by Path starting $E-3+C$ or $5-A+1$	(M1) (M1)		
	$D-2+A-1+C-3+B-4+F-6$ followed by $E-3+C-1+A-5$	(A1) (A1)	Or reverse Or reverse	
	Or			
	III Path starting $E-3+B$ or $5-A+2$ followed by Path starting $D-2+B$ or $6-F+4$	(M1) (M1)		
	$E-3+B-2+A-5$ followed by $D-2+B-4+F-6$	(A1) (A1)	Or reverse Or reverse	
	Matching $A5, B4, C1, D2, E3, F6$	B1		
		Total		

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)	<p>AC AD CE EH HG AB DF</p>	<p>M1 B1 A1 A1</p>	4	<p>Use of Prim's, first three edges (not numbers) correct 7 different edges Correct up to and including AB 6th All correct</p>
(ii)		<p>M1 A1</p>		<p>Spanning tree, no cycles, 8 vertices, 7 edges Correct, including labels but ignore any lengths</p>
(iii)	£1170	B1	1	Must include units.
(b)	<p>Replace CE with DG New cost £1200 or (value of their "£1170" + £30)</p>	<p>M1 A1F</p>	2	<p>PI Must include units.</p>
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 $15 + 14 + \dots + 1$ 120	M1 A1	1 2	
Total			5	

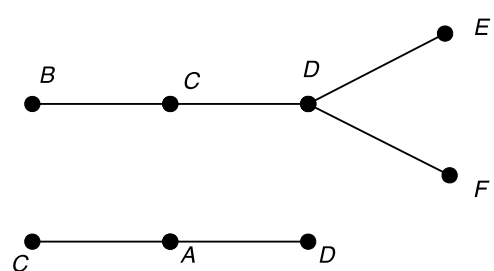
Q4	Solution	Mark	Total	Comment
4 (a) (i)		M1 A1 m1 A1 B1		Use of Dijkstra; two values at <i>E</i> and one at each of <i>G</i> and <i>H</i> Correct values only at <i>E</i> 2 values at each of <i>D</i> , <i>F</i> and <i>I</i> . Completely correct including all crossing out and boxing 19 at <i>J</i> . If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

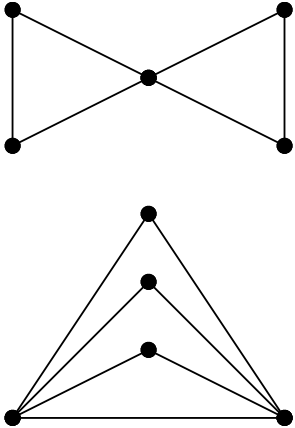
Q5	Solution	Mark	Total	Comment
5 (a)	$AB+CG = (50 + 240) = 290$	M1	5	These 3 pairs stated including the intention to add 3 correct totals, 2 correct totals Of three totals PI CSO Must include units
	$AC+BG = (100 + 230) = 330$	A2,1		
	$AG+BC = (210 + 70) = 280$	m1		
	Solution = 1400 + their min total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

Notes:

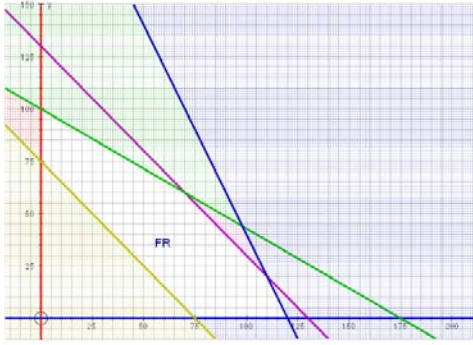
For 5(a), SC if M0 scored then 1680 m scores 2/5. Must include units.

For 5(a), SC if M0 scored then 1680 scores 1/5 (no units)

Q	Solution	Mark	Total	Comment																																																	
6 (a)	<table border="1" style="margin-left: 20px;"> <tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td></tr> <tr><td>A</td><td>-</td><td>7</td><td>6</td><td>5</td><td>7</td><td>10</td></tr> <tr><td>B</td><td>7</td><td>-</td><td>5</td><td>9</td><td>14</td><td>12</td></tr> <tr><td>C</td><td>6</td><td>5</td><td>-</td><td>4</td><td>10</td><td>8</td></tr> <tr><td>D</td><td>5</td><td>9</td><td>4</td><td>-</td><td>6</td><td>5</td></tr> <tr><td>E</td><td>7</td><td>14</td><td>10</td><td>6</td><td>-</td><td>10</td></tr> <tr><td>F</td><td>10</td><td>12</td><td>8</td><td>5</td><td>10</td><td>-</td></tr> </table>		A	B	C	D	E	F	A	-	7	6	5	7	10	B	7	-	5	9	14	12	C	6	5	-	4	10	8	D	5	9	4	-	6	5	E	7	14	10	6	-	10	F	10	12	8	5	10	-	B2,1,0	2	- 1 each independent error
	A	B	C	D	E	F																																															
A	-	7	6	5	7	10																																															
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D	5	9	4	-	6	5																																															
E	7	14	10	6	-	10																																															
F	10	12	8	5	10	-																																															
(b) (i)	(7+10+12+5+4+5 =) 43	B1	1	A possible solution to the problem, OE																																																	
(ii)	It is a Hamiltonian cycle	E1	1																																																		
(c)	DCBAEFD (= 4+5+7+7+10+5 =) 38	M1 A1 B1	3	Hamiltonian cycle from D Correct order Correct length																																																	
(d)	<table border="1" style="margin-left: 20px;"> <tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td></tr> <tr><td>A</td><td>-</td><td>7</td><td>6</td><td>5</td><td>7</td><td>10</td></tr> <tr><td>B</td><td>7</td><td>-</td><td>5</td><td>9</td><td>14</td><td>12</td></tr> <tr><td>C</td><td>6</td><td>5</td><td>-</td><td>4</td><td>10</td><td>8</td></tr> <tr><td>D</td><td>5</td><td>9</td><td>4</td><td>-</td><td>6</td><td>5</td></tr> <tr><td>E</td><td>7</td><td>14</td><td>10</td><td>6</td><td>-</td><td>10</td></tr> <tr><td>F</td><td>10</td><td>12</td><td>8</td><td>5</td><td>10</td><td>-</td></tr> </table>  <p>MST BC, CD, DE, DF Edges from A: AC, AD</p> <p>(5+4+6+5)+(6+5) = 31</p>		A	B	C	D	E	F	A	-	7	6	5	7	10	B	7	-	5	9	14	12	C	6	5	-	4	10	8	D	5	9	4	-	6	5	E	7	14	10	6	-	10	F	10	12	8	5	10	-	M1 A1 A1 B1	4	6 different edges, not just numbers, of which exactly 2 are from A (seen in diagram, listed or in table) Correct MST (seen in diagram, listed or in table) Correct edges from A (listed, in table or seen in diagram and clearly identified)
	A	B	C	D	E	F																																															
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E	7	14	10	6	-	10																																															
F	10	12	8	5	10	-																																															
(e)	$31 < T \leq 38$	B1 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	2	Either value, with no incorrect values, Or both correct and ONE other value. Both values correct and no others
(b)	$(n =) 3, 4, 5$ or 6	B1		
(c)		B1	2	All correct with no extra values
		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)	<table border="1"> <thead> <tr> <th>N</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>Print</th> </tr> </thead> <tbody> <tr><td>5</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td>1</td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td>1</td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td>0</td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td>1</td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>2</td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>1</td></tr> <tr><td>4</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td>1</td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td>2</td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td>2</td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>3</td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>1</td></tr> <tr><td>3</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td>2</td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td>3</td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td>4</td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>5</td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>2</td></tr> <tr><td>2</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td>3</td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td>5</td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td>7</td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>8</td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>3</td></tr> <tr><td>1</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td>5</td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td>8</td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td>12</td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>13</td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>5</td></tr> <tr><td>0</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>12</td></tr> </tbody> </table>	N	A	B	C	D	Print	5							1							1							0						1							2							1	4							1							2							2							3							1	3							2							3							4							5							2	2							3							5							7							8							3	1							5							8							12							13							5	0											12	<p>M1</p> <p>For N: sequence “5,4,3”</p> <p>A1</p> <p>For N: sequence “5,4,3,2,1,0”</p> <p>A1</p> <p>For B: sequence “1,2,3,5,8” and for D: sequence “2,3,5,8,13”</p> <p>B1</p> <p>All prints seen and correct</p> <p>A1</p> <p>Complete correct solution including all prints seen</p>	5	<p>For all marks: for each column/variable, condone 0s at the beginning of sequences and any repeated values</p> <p>For N: sequence “5,4,3”</p> <p>For N: sequence “5,4,3,2,1,0”</p> <p>For B: sequence “1,2,3,5,8” and for D: sequence “2,3,5,8,13”</p> <p>All prints seen and correct</p> <p>Complete correct solution including all prints seen</p>
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(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) $400x + 400y + 600z \leq 130000$ ($2x + 2y + 3z \leq 650$) $200x + 500y + 200z \leq 70000$ ($2x + 5y + 2z \leq 700$) $400x + 100y + 200z \leq 72000$ ($4x + y + 2z \leq 720$) $z \geq 75$	B1	4	OE	
		B1		OE	
		B1		OE	
		B1		OE but z terms must be collected	
	(b) Substitute $z = x + y$ $2x + 2y + 3z \leq 650 \Rightarrow 5x + 5y \leq 650$ $\Rightarrow x + y \leq 130$ $2x + 5y + 2z \leq 700 \Rightarrow 4x + 7y \leq 700$ $4x + y + 2z \leq 720 \Rightarrow 6x + 3y \leq 720$ $\Rightarrow 2x + y \leq 240$ $z \geq 75 \Rightarrow x + y \geq 75$	M1	2	Clear substitution of $z = x + y$ into one of the first three inequalities	
		A1		All correct. AG. (with middle line in 1 st and 3 rd inequalities)	
	(c)		B1 B1 B1 B1	5	All points correct to within $\pm\frac{1}{2}$ a small square vertically and horizontally and lines ruled
	(d) $(P =) 50x + 100y + 150z$ $(P =) 200x + 250y$	M1 A1	2		PI or seen ISW
	(e) (i)	Either OL drawn with gradient -0.8	M1	2	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
(ii)	or $(0, 100) P = \pounds 25000$ $(70, 60) P = \pounds 29000$ $(110, 20) P = \pounds 27000$ $(120, 0) P = \pounds 24000$ so max at $x = 70, y = 60$	(M1)	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 .	
	$P = \pounds 29000$ 70 tonnes Basic, 60 (tonnes) Premium, 130 (tonnes) Supreme	(A1 CSO)		Must be clearly chosen from these four correct values	
		B1	2	Including \pounds	
		B1		All three correct, including units. (Not just $x = 70, y = 60$ and $z = 130$.)	
	Total		17		

