

# Mark Scheme (Results) January 2011

GCE

## GCE Decision Mathematics D1 (6689/01)

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January 2011

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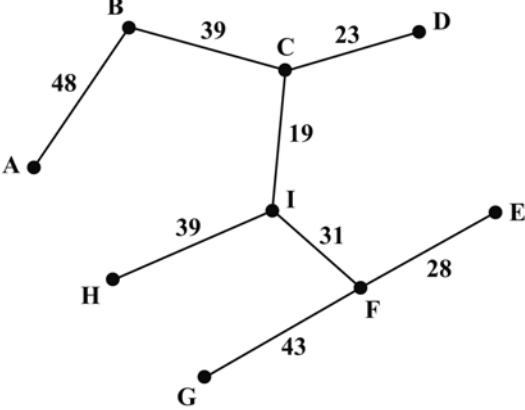
January 2011  
Decision Mathematics D1 6689  
Mark Scheme

Question Number	Scheme	Marks
1. (a)	<p>The length of the shortest route is 21 miles</p>	<p>M1 A1 A1ft A1</p> <p>A1ft (5)</p>

Question Number	Scheme	Marks
(b)	Shortest route: A B C E G F H	B1 (1)
(c)	Shortest route: H F G E C Length of shortest route: $21 - 7 = 14$ miles	B1ft B1ft (2) [8]
<b>Notes</b>		
(a)	1M1: Smaller number replacing larger number in the working values at C or D or G or E or F or H. (generous – give bod) 1A1: All values in boxes A, B and C correct. (Condone missing wv at A) (Allow order of labelling starting at 0) 2A1ft: All values in boxes D, E and G (ft) correct . Penalise order of labelling errors just once, G must be labelled before F. 3A1: All values in boxes F and H correct 4A1ft: Follow through from their H value, condone lack of units here.	
(b)	1B1: CAO (either way round)	
(c)	1B1ft: only ft if their shortest route goes through C, in which case accept their route reversed up to C (either way round) 2B1ft: only ft if their shortest route goes through C, in which case accept their route length (or final value at H) -7.	

Question Number	Scheme	Marks																																																								
2.  (a)	Lower bound = $\frac{173}{50} = 3.46$ so 4 bins	B1 B1  (2)																																																								
(b)	Bin 1: 23 + 11 + 10 Bin 2: 29 + 14 Bin 3: 34  Bin 4: 35 Bin 5: 17	M1 A1 A1  (3)																																																								
(c)	e.g.  <table border="1"> <tr><td>23</td><td>29</td><td>11</td><td>34</td><td>10</td><td>14</td><td>35</td><td>17</td></tr> <tr><td>29</td><td>23</td><td>34</td><td>11</td><td>14</td><td>35</td><td>17</td><td>10</td></tr> <tr><td>29</td><td>34</td><td>23</td><td>14</td><td>35</td><td>17</td><td>11</td><td>10</td></tr> <tr><td>34</td><td>29</td><td>23</td><td>35</td><td>17</td><td>14</td><td>11</td><td>10</td></tr> <tr><td>34</td><td>29</td><td>35</td><td>23</td><td>17</td><td>14</td><td>11</td><td>10</td></tr> <tr><td>34</td><td>35</td><td>29</td><td>23</td><td>17</td><td>14</td><td>11</td><td>10</td></tr> <tr><td>35</td><td>34</td><td>29</td><td>23</td><td>17</td><td>14</td><td>11</td><td>10</td></tr> </table> <p>List sorted - no more changes</p>	23	29	11	34	10	14	35	17	29	23	34	11	14	35	17	10	29	34	23	14	35	17	11	10	34	29	23	35	17	14	11	10	34	29	35	23	17	14	11	10	34	35	29	23	17	14	11	10	35	34	29	23	17	14	11	10	M1  A1  A1ft   A1cso  (4)
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(d)          Alt (c)	Bin 1: 35 + 14 Bin 2: 34 + 11  Bin 3: 29 + 17 Bin 4: 23 + 10          <table border="1"> <tr><td>23</td><td>29</td><td>11</td><td>34</td><td>10</td><td>14</td><td>35</td><td>17</td></tr> <tr><td>35</td><td>23</td><td>29</td><td>11</td><td>34</td><td>10</td><td>14</td><td>17</td></tr> <tr><td>35</td><td>34</td><td>23</td><td>29</td><td>11</td><td>17</td><td>10</td><td>14</td></tr> <tr><td>35</td><td>34</td><td>29</td><td>23</td><td>17</td><td>11</td><td>14</td><td>10</td></tr> <tr><td>35</td><td>34</td><td>29</td><td>23</td><td>17</td><td>14</td><td>11</td><td>10</td></tr> </table> <p>A1</p> <p>A1ft</p>	23	29	11	34	10	14	35	17	35	23	29	11	34	10	14	17	35	34	23	29	11	17	10	14	35	34	29	23	17	11	14	10	35	34	29	23	17	14	11	10	M1 A1 A1cso  (3) [12]																
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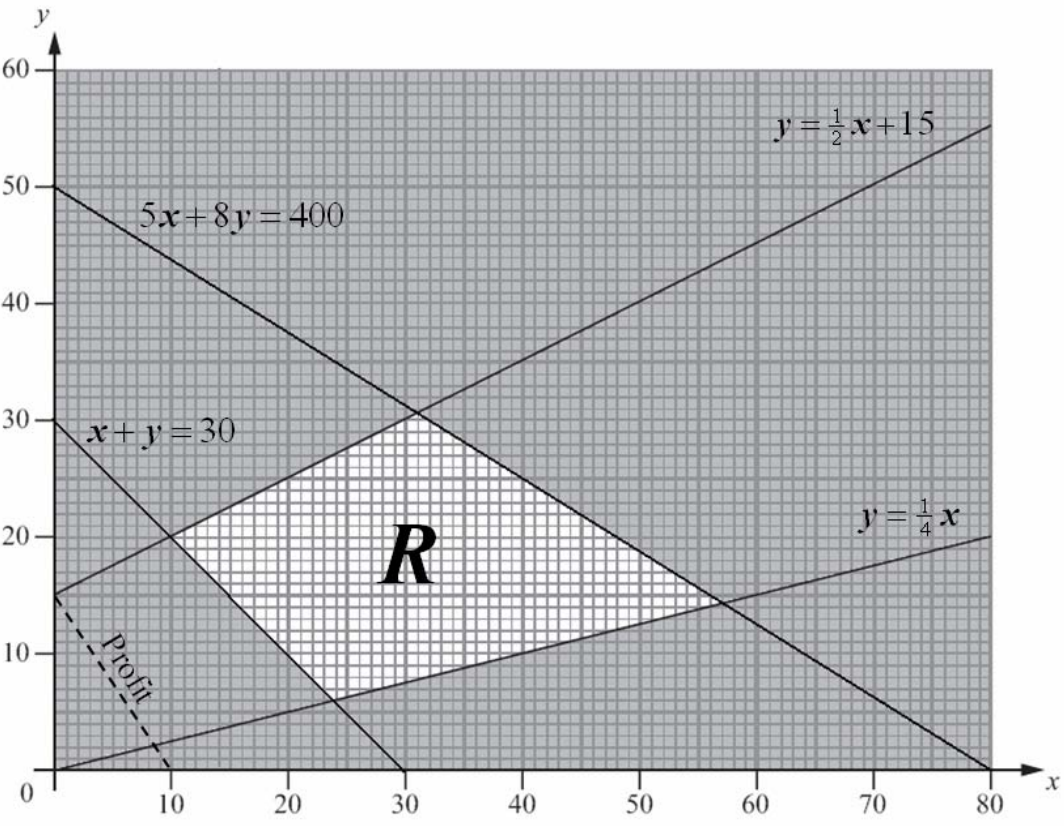
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<b>Notes</b>																																										
(a)	1M1= 1B1: Cao 4 1A1= 2B1: either $(173 \pm 20) \div 50$ or $3 < \text{answer} < 4$ seen.																																									
(b)	1M1: First four items placed correctly and at least 6 values put in bins 1A1: Bin 1 correct (condone cumulative totals) 2A1: All correct (condone cumulative totals)																																									
(c)	1M1: Bubble sort, one pass complete end term 35 or 10, consistent direction. 1A1: First two passes correct 2A1ft: Next two passes correct 3A1: cso + 'final' or re-listing etc.																																									
(d)	1M1: Bin 3 correct and at least 6 values put in bins 1A1: two bins correct (condone cumulative totals) 2A1: cso (condone cumulative totals)																																									
<b>Misread for Q2(c)</b>	<b>Sorting into ascending order</b> <b>If list reversed into descending order at end, allow full marks</b>																																									
	(i) Left to right <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr><td>23</td><td>29</td><td>11</td><td>34</td><td>10</td><td>14</td><td>35</td><td>17</td></tr> <tr><td>23</td><td>11</td><td>29</td><td>10</td><td>14</td><td>34</td><td>17</td><td>35</td></tr> <tr><td>11</td><td>23</td><td>10</td><td>14</td><td>29</td><td>17</td><td>34</td><td>35</td></tr> <tr><td>11</td><td>10</td><td>14</td><td>23</td><td>17</td><td>29</td><td>34</td><td>35</td></tr> <tr><td>10</td><td>11</td><td>14</td><td>17</td><td>23</td><td>29</td><td>34</td><td>35</td></tr> </tbody> </table> <p style="text-align: right; margin-right: 20px;">A1</p> <p style="text-align: right; margin-right: 20px;">A1ft</p> <p>List in order</p>	23	29	11	34	10	14	35	17	23	11	29	10	14	34	17	35	11	23	10	14	29	17	34	35	11	10	14	23	17	29	34	35	10	11	14	17	23	29	34	35	
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Question Number	Scheme	Marks
3.	(a) CI CD (not DI) EF FI (not EI not DE) $\begin{Bmatrix} BC \\ HI \end{Bmatrix}$ (not BI) GF (not GI not HG) AB	M1 A1 A1 (3)
	(b) AB BC CI CD FI EF IH FG	M1 A1 A1 (3)
(c)	 <p>Weight: 270</p>	B1  B1 (2)
	(d) Start off the tree with DI and HG and then apply Kruskal's algorithm	B2, 1, 0 (2) [10]
<b>Notes</b>		
(a)	1M1: Kruskal's algorithm – first 4 arcs selected chosen correctly. 1A1: All eight non-rejected arcs chosen correctly.(Working seen in (a)) 2A1: All rejections correct and in correct order and at correct time.	
(b)	1M1: Prim's algorithm – first four arcs chosen correctly, in order, or first five nodes chosen correctly, in order. {A, B,C,I, D} (arcs not arc lengths) 1A1: First six arcs chosen correctly; all 9 nodes chosen correctly, in order. {A,B,C,I,D,F,E,H,G}[1 2 3 5 7 6 9 8 4] 2A1: cso	
(c)	1B1: cao (condone lack of numbers) 2B1: 270 cao	
(d)	1B1: Kruskal's algorithm + some argument 2B1: Kruskal's algorithm + start with the two arcs. (o.e)	

Question Number	Scheme	Marks														
4.																
(a)	Bipartite graph	B1														
(b)	e.g. $J - 3 = B - 6 = K - 1$ Change status $J = 3 - B = 6 - K = 1$ $A = 2 \quad B = 6 \quad (D \text{ unmatched}) \quad J = 3 \quad K = 1 \quad M = 5$	M1 A1 A1 (3)														
(c)	e.g. $D - 2 = A - 6 = B - 1 = K - 4$ Change status $D = 2 - A = 6 - B = 1 - K = 4$ $A = 6 \quad B = 1 \quad D = 2 \quad J = 3 \quad K = 4 \quad M = 5$	M1 A1 A1 (3) [7]														
<u>Notes:</u>																
(a)	1B1: Cao, but be charitable on spelling, award if phonetically close.															
(b)	1M1: Path from J to 1 or 4 (or vice versa) 1A1: CAO including change status (stated or shown), chosen path clear. 2A1: CAO must fit from stated path, diagram ok															
(c)	1M1: Path from D to 4 or 1 (or vice versa) 1A1: CAO including change status (stated or shown),but only penalise once per question, chosen path clear. 2A1: CAO must fit from stated paths, diagram ok. Must have both M's.															
Alternative answers:																
(b)	<table border="1"> <thead> <tr> <th>Path</th> <th>A B D J K M</th> </tr> </thead> <tbody> <tr> <td><math>J - 3 - B - 1</math></td> <td>2 1 - 3 6 5</td> </tr> <tr> <td><math>J - 3 - B - 6 - K - 1</math></td> <td>2 6 - 3 1 5</td> </tr> <tr> <td><math>J - 3 - B - 6 - K - 4</math></td> <td>2 6 - 3 4 5</td> </tr> </tbody> </table>	Path	A B D J K M	$J - 3 - B - 1$	2 1 - 3 6 5	$J - 3 - B - 6 - K - 1$	2 6 - 3 1 5	$J - 3 - B - 6 - K - 4$	2 6 - 3 4 5							
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5.  (a)	$AD + FI = 4.5 + 5.3 = 9.8$ $AF + DI = 5.8 + 3.9 = 9.7$ smallest $AI + DF = 5.9 + 5.1 = 11.0$  e.g. ABDGIGDEIHFEACFEA	M1 A1 A1 A1 A1 (5)
(b)	Roads AE, EF (or AEF), DG and GI (or DGI) should be repeated.  Length is $31.6 + 9.7 = 41.3$ km	B1  M1A1ft
(c)	We now only have to repeat one pair of odd vertices, one of which can not be D. ( $FI = 5.3$ , $AF = 5.8$ and $AI = 5.9$ )  FI gives the smallest of the three so choose to repeat FI (FHI)  The machine should be collected from A.	M1  A1  DA1  (3) [11]
<b>Notes</b>		
(a)	1M1: Three pairings of their four odd nodes 1A1: one row correct 2A1: two rows correct 3A1: all correct 4A1: Any correct route (17 nodes)	
(b)	1B1: correct <b>arcs</b> identified 1M1: $31.6 + ft$ their least, from a choice of at least two. 1A1: ft has correctly their plausible least (from a choice of at least two) to 31.6.	
(c)	1M1: Identifies need to repeat one pairing, not including D (maybe implicit) or listing of potential repeats. 1A1: Identifies FI as least. 2DA1: dependent on their identifying FI as repeat	

Question Number	Scheme	Marks
6.	 <p>(a) <math>4y \geq x</math> o.e.</p> <p><math>2y \leq x + 30</math> o.e</p>	<p>B1 B1</p> <p>B1 B1</p> <p>(4)</p>
(b)	<p><math>x + y = 30</math> and <math>5x + 8y = 400</math> added to the graph shading correct R correct</p>	<p>B1, B1 B1ft B1</p> <p>(4)</p>
(c)	<p>Profit line attempted Correct profit line (10, 20)</p>	<p>M1 A1 B1</p> <p>(3)</p> <p>[11]</p>

Question Number	Scheme	Marks
<u>Notes</u>		
<p>(a)</p> <p>(b)</p>	<p>1B1: ratio of coefficients correct (i.e. equation of line correct)  2B1: inequality correct way round.(<math>ay \geq bx</math> o.e.)  3B1: ratio of coefficients correct (i.e equation of line correct)  4B1: inequality correct way round.</p> <p>1B1: <math>x + y = 30</math> drawn cao  2B1: <math>5x + 8y = 400</math> drawn cao  3B1ft: shading correct or implied from lines with negative gradient.  4B1: cao</p>	
(c)	<p>1M1: Profit line – intersecting both axes. Minimum (2,0) to (0,3). Accept reciprocal gradient here.  1A1: a correct line  2A1=1B1: cao (e.g not ‘<math>10x + 20y</math>’)</p>	

Question Number	Scheme	Marks														
7.  (a)	<table border="1"> <thead> <tr> <th>Activity</th> <th>Immediately preceding activities</th> </tr> </thead> <tbody> <tr> <td>G</td> <td>B, C</td> </tr> <tr> <td>H</td> <td>E, F</td> </tr> <tr> <td>I</td> <td>D, E, F</td> </tr> <tr> <td>J</td> <td>G, H</td> </tr> <tr> <td>K</td> <td>G, H, I</td> </tr> <tr> <td>L</td> <td>G, H, I</td> </tr> </tbody> </table>	Activity	Immediately preceding activities	G	B, C	H	E, F	I	D, E, F	J	G, H	K	G, H, I	L	G, H, I	B3,2,1,0 (3)
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I	D, E, F															
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K	G, H, I															
L	G, H, I															
(b)	<p>Dummy from 6 to 7 needed because K and L depend on G H and I, but J depends on G and H only.</p> <p>Dummy from 8 to 9 needed because no two activities may share both the same start event number and the same finish event number.</p>	B3,2,1,0 (3)														
(c)		M1 A1 M1 A1  (4)														
(d)	Critical activities: A C $\begin{Bmatrix} F & H \\ G \end{Bmatrix}$ J	B2,1,0 (2)														
(e)	Total float on activity K= $21 - 14 - 5 = 2$	M1 A1ft (2)														
(f)	Lower bound is $\frac{54}{21} = 2.57 = 3$	B1 B1ft (2) [16]														

Question Number	Scheme	Marks
<b><u>Notes</u></b>		
(a)	1B1: Any two rows correct 2B1: Any 4 rows correct 3B1: all correct	
(b)	1B1: first dummy (precedence) explained, maybe confused, be generous, give bod. 2B1: first dummy clearly explained – all relevant activities referred to. Must refer to K and/or L; H and/or G; I and J 3B1: second dummy (uniqueness) explained, maybe confused, be generous, give bod.	
(c)	1M1: All top boxes completed generally increasing left to right.(Condone one rogue) 1A1: cao. 2M1: All bottom boxes completed generally decreasing right to left. (Condone one rogue) 2A1: cao.	
(d)	1B1: Critical activities correct condone one omission or extra. SC allow ACGJ for B1 only 2B1: Critical activites cao	
(e)	1M1ft: Correct calculation seen – all three numbers at least once. 1A1ft: Float correct >0	
(f)	1M1 = 1B: 3 1A1ft= 2B1ft:Correct calculation seen or ' 2< answer< 3	

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