

# Mark Scheme (Results) January 2011

GCE

## GCE Decision Mathematics D1 (6689/ 01)

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January 2011

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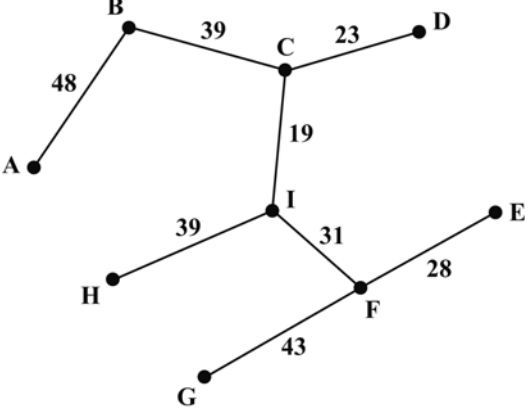
January 2011  
Decision Mathematics D1 6689  
Mark Scheme

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 4: 35 Bin 2: 29 + 14                              Bin 5: 17 Bin 3: 34	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> List sorted - no more changes	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 3: 29 + 17 Bin 2: 34 + 11                              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>	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]  A1 A1ft																
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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)																																									
Misread for Q2(c)	<b>Sorting into ascending order</b> <b>If list reversed into descending order at end, allow full marks</b>																																									
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	<b>Numbers changing during the course of the sort</b>																																									
	<ul style="list-style-type: none"> <li>• If the number change does not alter the sort (e.g. 23 becomes 25) remove final A only. If persists in (d) but does not affect answer similarly remove final A only in (d).</li> <li>• If the number alters the sort (e.g 23 becomes 32) mark as a misread in (c) and if persists in (d) mark (c) and (d) together as a misread – so just take 2 marks off in total for these two sections.</li> </ul>																																									

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)	

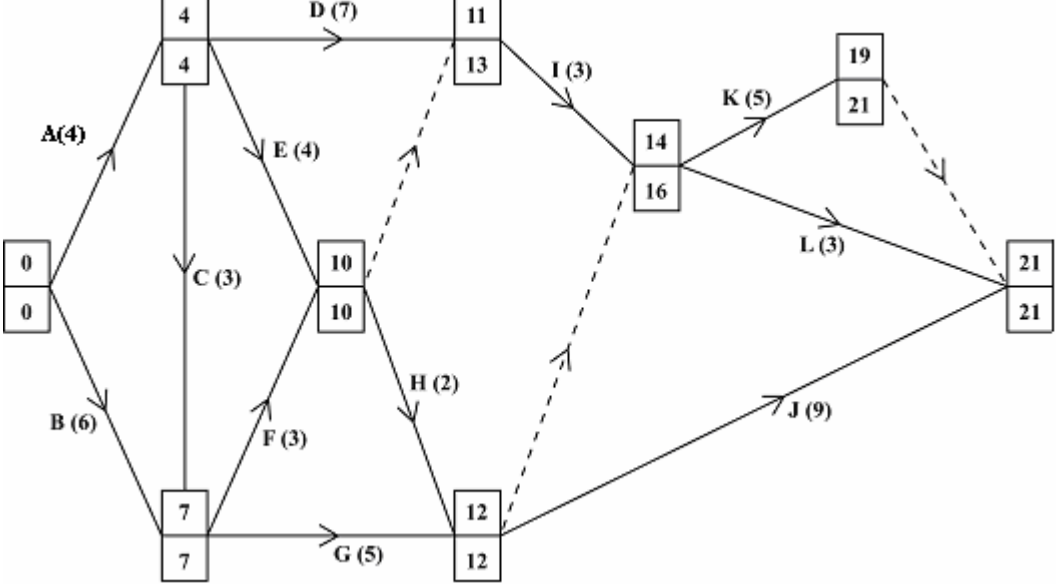
Question Number	Scheme	Marks														
4.																
(a)	Bipartite graph	B1														
(b)	e.g. $J - 3 = B - 6 = K - 1$ Change status $J = 3 - B = 6 - K = 1$ $A = 2 \quad B = 6 \quad (D \text{ unmatched}) \quad J = 3 \quad K = 1 \quad M = 5$	M1 A1 A1 (3)														
(c)	e.g. $D - 2 = A - 6 = B - 1 = K - 4$ 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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Question Number	Scheme	Marks
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>The graph shows a coordinate system with x and y axes. The x-axis is labeled from 0 to 80 in increments of 10. The y-axis is labeled from 0 to 60 in increments of 10. A shaded region R is bounded by the following lines: <ul style="list-style-type: none"> <li><math>x + y = 30</math> (intercepts at 30, 0 and 0, 30)</li> <li><math>5x + 8y = 400</math> (intercepts at 80, 0 and 0, 50)</li> <li><math>y = \frac{1}{2}x + 15</math> (intercepts at 0, 15 and 60, 45)</li> <li><math>y = \frac{1}{4}x</math> (intercepts at 0, 0 and 80, 20)</li> </ul> A dashed line labeled 'Profit' is drawn from (0, 15) to (10, 0). The region R is the area bounded by these lines in the first quadrant.</p>	
(a)	$4y \geq x$ o.e.  $2y \leq x + 30$ o.e	B1 B1  B1 B1  (4)
(b)	$x + y = 30$ and $5x + 8y = 400$ added to the graph shading correct R correct	B1, B1 B1ft B1  (4)
(c)	Profit line attempted Correct profit line (10, 20)	M1 A1 B1  (3)  [11]

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)
Activity	Immediately preceding activities															
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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
	<u>Notes</u>	
(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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