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Mark Scheme (Results)

June 2011

GCE Decision D1 (6689) Paper 1

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EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

   - M marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - A marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - B marks are unconditional accuracy marks (independent of M marks)
   - Marks should not be subdivided.

3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol ^ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - * The answer is printed on the paper
   - ⌊ The second mark is dependent on gaining the first mark

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June 2011
Decision Mathematics D1 6689
Mark Scheme

Question Number	Scheme	Marks
1. **(a)**	The list is not in alphabetical order.	B1 (1)
(b)	E.g. A Quick sort J M C B T H K R G F — H C B G F H J M T K R — G T C B F G H J M K R T — B K B C F G H J K M R T — F R B C F G H J K M R T Sort complete + named correctly	M1 A1 A1 A1= B1 (4)
(c)	Pivot 1 = $\left[\frac{1+10}{2}\right] = 6$ Jenny reject 1 - 6 Pivot 2 = $\left[\frac{7+10}{2}\right] = 9$ Richard reject 9 - 10 Pivot 3 = $\left[\frac{7+8}{2}\right] = 8$ Merry reject 8 Pivot 4 = 7 Kim - name found	M1 A1 A1ft A1 (4) **9**

Notes:

(a) B1 CAO – phonetically close

(b) M1 Quick sort – pivots, p, selected and first pass gives <p, p, >p.

1A1 First two passes correct, pivots chosen consistently for third pass

2A1 CAO Sort completed correctly

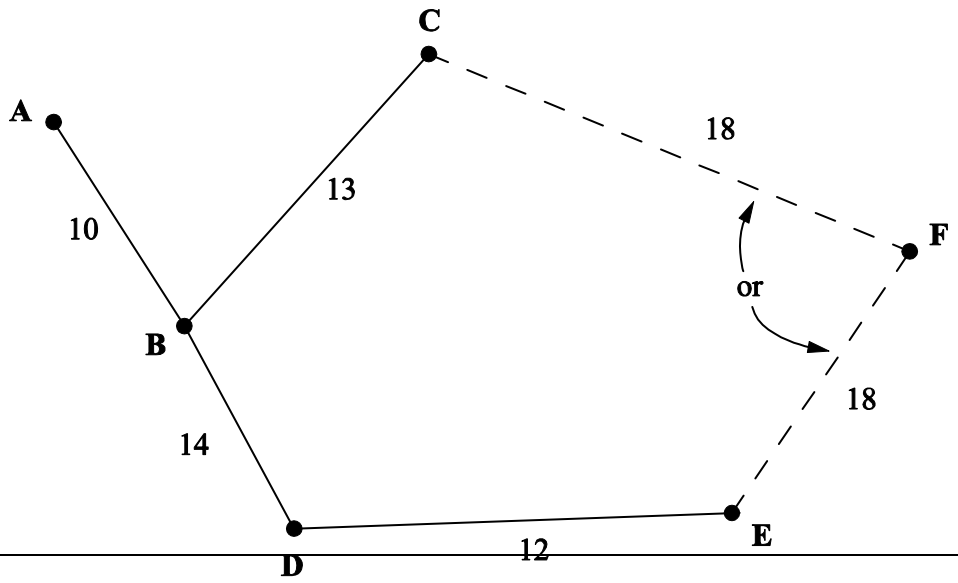
3A1=2B1 'Stop' + plus correct name for their sort – phonetically close

(c) M1 Using their 'sorted list' + choosing middle right pivots+ discarding/retaining half the list. It their list is not in full alphabetical order M1 only.

1A1 First pass correct ie 6^{th} item for a correct list (no sticky pivots)

2A1 Second and third passes correct ie 9^{th} and 8^{th} items from a correct list (no sticky pivots)

3A1 CSO search complete + 'found'

Question Number	Scheme	Marks
2. **(a)(i)**	A tree is a connected graph with no cycles/circuit	B1
(a)(ii)	A minimum spanning tree is a tree that contains all vertices and the total length of its arcs (weight of tree) is as small as possible.	B1 B1 (3)
(b)	AB, DE, BC; $\left\{\begin{matrix}\text{reject AC}\\ \text{BD}\end{matrix}\right\}$ reject BE, reject CE, use either EF or CF	M1; A1 A1 (3)
(c)		B1 (1)
(d)	No, there are two solutions since either EF or CF should be used.	B1 (1) **8**

Notes

(a)1B1 Connected + no cycles
2B1 Contains all vertices
3B1 Total length of arcs used minimised or minimum weight. (Not shortest/smallest etc.)
(b)M1 First four arcs selected correctly in correct order.
1A1 Arcs selected correctly at correct time
2A1 Rejections correct and at correct time
(c)B1 CAO
(d)B1 CAO - mark explanation must specify two arcs of 18 or two 18's or ref to EF and CF

Question Number	Scheme	Marks
3. **(a)**	$6x+5y \le 60$ $2x+3y \ge 12$ $3x \ge 2y$ $x \le 2y$	B2,1,0 (2)
(b)	Drawing objective line{ (0,3) (1,0)} Testing at least 2 points Calculating optimal point Testing at least 3 points $\left(7\frac{1}{17}, 3\frac{9}{17}\right) = \left(\frac{120}{17}, \frac{60}{17}\right) \approx (7.06, 3.53)$	M1 A1 DM1 A1 awrt (4)
(c)	$24\frac{12}{17} = \frac{240}{17} \approx 24.7$ (awrt)	B1 (1)
(d)	(6,4)	B1 (1) **8**

Notes:

$\left(3\frac{3}{7}, 1\frac{5}{7}\right) = \left(\frac{24}{7}, \frac{12}{7}\right) \approx (3.43, 1.71) \rightarrow 12$

$\left(1\frac{11}{13}, 2\frac{10}{13}\right) = \left(\frac{24}{13}, \frac{36}{13}\right) \approx (1.85, 2.77) \rightarrow 8.3\,07692 \ \left(8\frac{4}{13} = \frac{108}{13}\right)$

$\left(4\frac{4}{9}, 6\frac{2}{3}\right) = \left(\frac{40}{9}, \frac{20}{3}\right) \approx (4.44, 6.67) \rightarrow 20$

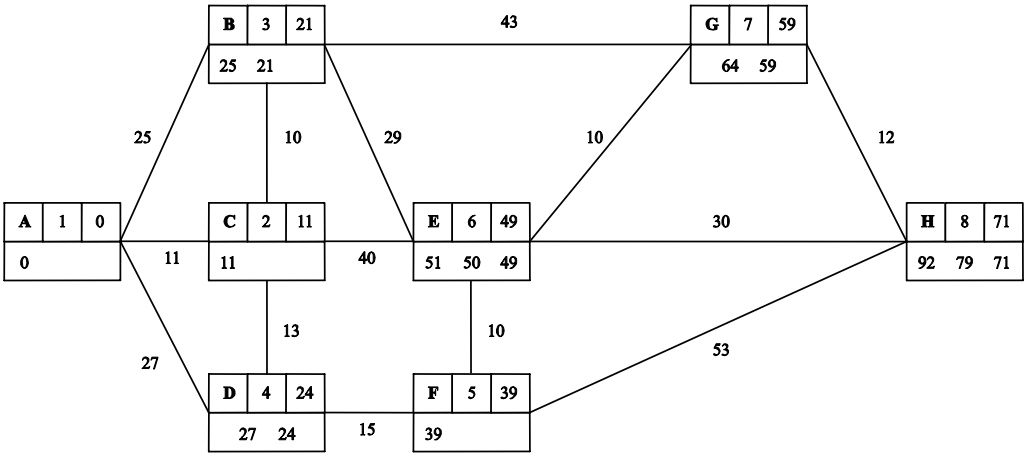
$\left(7\frac{1}{17}, 3\frac{9}{17}\right) = \left(\frac{120}{17}, \frac{60}{17}\right) \approx (7.06, 3.53) \rightarrow 24.7\,05882 \ \left(24\frac{12}{17} = \frac{420}{17}\right)$

Notes

(a)1B1 Any two inequalities correct, accept < and > here (but not = of course).
2B1 All four correct. Must be $\le$ and $\ge$ here
(b)1M1 Drawing objective line or its reciprocal OR testing two vertices in the feasible region (see list above) points correct to 1 dp.
1A1 Correct objective line OR two points correctly tested (1 dp ok)
2DM1 Calculating optimal point either answer to 2 dp or better or using S.E's (correct 2 equations for their point + attempt to eliminate one variable.); OR Testing three points correctly and optimal one to 2dp.
2A1 CAO 2 dp or better.
(c)B1 CAO
(d)B1 CAO not (4,6).

Question Number	Scheme	Marks
4. **(a)**	[Given $A-3=R-4=C-5$] $A-1=H-2$ $A-1=H-3=R-4=C-5$	M1 A1 A1 (3)
(b)	$A=3, C=5,\ H=1,\ (\text{J unmatched}),\ R=4$	B1 (1)
(c)	Alternating path : $J-4=R-3=A-1=H-2$ Change status : $J=4-R=3-A=1-H=2$ $A=1,\ C=5,\ H=2,\ J=4,\ R=3$	M1 A1 A1 (3) **7**
	Notes **(a)M1** Path from A to 2 or 5 - or vice versa **1A1** One correct path selected OR tree showing the missing two paths only. **2A1** Both correct paths listed separately **(b)B1** CAO **(c)M1** Path from J to 2 – or vice versa **1A1** Correct path including change status **2A1** CAO must follow through from stated path.	

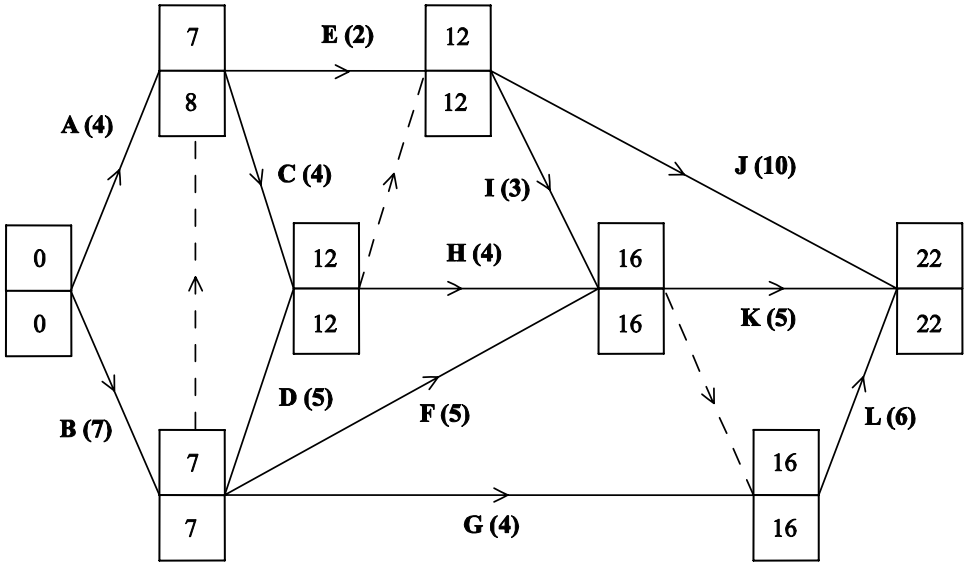
Question Number	Scheme	Marks
5. **(a)**	$AC + DF = 9 + 13 = 22 \leftarrow$ $AD + CF = 16 + 8 = 24$ $AF + CD = 17 + 7 = 24$ Repeat **arcs** AC, DG and GF	M1 A1 A1 A1 A1ft (5)
(b)	E.g. ADCACGDGFGECBEFBA Length of route $= 98 + 22 = 120(\text{km})$	B1 B1ft (2)
(c)	CF (8) is the shortest link between 2 odd nodes excluding D Repeat CF (8) since this is the shortest path excluding D. We finish at A Length of route = 98 + 8 = 106 (km)	M1 A1ft A1ft (3) **10**
	Notes **(a)M1** Three pairings of their four odd nodes **1A1** One row correct including pairing and total **2A1** Two rows correct including pairing and total **3A1** Three rows correct including pairing and total **4A1ft** Their smallest repeated **arcs** stated accept DGF or arcs clear from selected row. **(b)1B1** Correct route any start point, 17 nodes, AC, DG and GF repeated **2B1ft** CAO 98 + their least out of a choice of at least 2. **(c)M1** Attempting just one repeated path excluding D; accept AC, AF and CF listed **1A1ft** **A** and their least repeat [should be CF (CEF)] **clearly stating this as least** **2A1ft** 98 + their least from their working in (a)	

Question Number	Scheme	Marks
6. **(a)**	 ACDFEGH Length 71 (km)	M1 A1 (ABCD) A1ft (EF) A1ft (GH) A1 A1ft (6)
(b)	E.g. 71 – 12 = 59 GH 49 – 10 = 39 FE 24 – 13 = 11 CD 59 – 10 = 49 EG 39 – 15 = 24 DF 11 – 11 = 0 AC Or Trace back from H including arc XY if (Y already lies on the path and) the difference of the final values of X and Y equals weight of arc XY.	B2,1,0 (2)
(c)	ACBEGH Length 72 (km)	B1 B1 (2) **10**
	Notes **(a)M1** Big replaced by smaller at least once at B or D or E or G or H **1A1** A, B, C, D boxes all correct, condone lack of 0 in ‘s working value **2A1ft** E and F ft correctly **3A1ft** G and H ft correctly **4A1** CAO **5A1ft** ft on their final value. **(b)1B1** Attempting an explanation, at least 3 stages or one half of general explanation **2B1** Correct explanation – all six stages, both halves of explanation **(c)1B1** CAO **2B1** CAO	

Question Number	Scheme	Marks
7. **(a)**		B3,2,1,0 (3)

Activity	Proceeded by	Activity	Proceeded by	Activity	Proceeded by
(A)	(-)	E	A B	I	C D E
(B)	(-)	(F)	(B)	J	C D E
C	A B	(G)	(B)	K	F H I
(D)	(B)	H	C D	L	F G H I

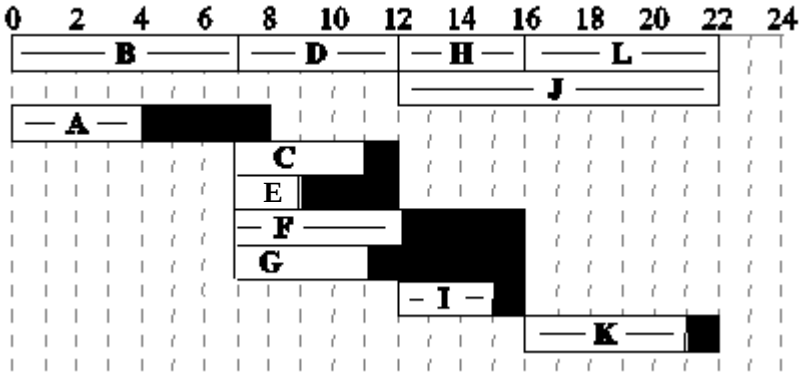
(b)



M1 A1
M1 A1
(4)

(c) Critical activities are B D J H L — M1 A1 (2)

(d)



M1 A1
M1 A1
(4)

Question Number	Scheme	Marks
(e)	E.g. Between time 7 and 16, 3 workers could do 3 x 9 = 27 days work. Activities C, D, E, F, G, H, I and 4 days of J need to be done This totals 31 days work. So it is not possible to complete the project with three workers. OR If three workers are used three activities H, J and I need to happen at time 13.5, this reduces the float on F and G, meaning that at 10.5 D, C, F and G need to be happening. Our initial assumption is incorrect hence four workers are needed.	B3,2,1,0 (3) **16**
	Notes **(a)1B1** Any two rows correct **2B1** Any four rows correct **3B1** All seven rows correct **(b)1M1** **All** top boxes complete, values generally increasing left to right, condone one rogue **1A1** CAO **2M1** **All** bottom boxes complete, values generally decreasing R to L, condone one rogue **2A1** CAO **(c)M1** Accept dummies, repeats and condone one absence or one extra; or BDHL or BDJ **A1** CAO (dummies and repeats ok) **(d)1M1** At least 9 activities including at least 4 floats. Do not accept scheduling diagram. **1A1** Critical activities dealt with correctly **2M1** All 12 activities including at least 7 floats **2A1** Non-critical activities dealt with correctly. **(e)1B1** Attempt at explanation – one correct idea. **2B1** Good explanation, some imprecise or vague statements – give bod **3B1** Fully correct explanation. No bod needed	

Question Number	Scheme	Marks
8.	Let x be the number of type A radios and y be the number of type B radios.	B1
	$(\text{Maximise P} =)15x+12y$	B1
	Subject to	
	$x \geq 50$	B1
	$\frac{1}{5}(x+y) < x$ (accept $\leq$) $[y < 4x]$	B1
	$\frac{2}{5}(x+y) > x$ (accept $\geq$) $[2y > 3x]$	B1
	$3x+2y \leq 200$	B1
	$y \geq 0$	B1
		7

Notes

1B1 Defining x and y; Must see 'number of'

2B1 CAO objective function $15x+12y$

3B1 CAO $x \geq 50$

4B1 CAO o.e $\frac{1}{5}(x+y) < x \Rightarrow y < 4x$

5B1 CAO o.e $\frac{2}{3}(x+y) > x \Rightarrow 2y > 3x$

6B1 CAO o.e $3x+2y \leq 200$

7B1 CAO $y \geq 0$

Question Number	Scheme	Marks
Q1 b	**Additional solutions** Quick sort middle left J M C B T H K R G F — T — M1 J M C B H K R G F T — H C B G F H J M K R T — B M — A1 B C G F H J K M R T — G J B C F G H J K M R T — C B C F G H J K M R T — A1 Quick sort complete — A1 Bubble sort left to right J M C B T H K R G F J C B M H K R G F T — T in place, consistent direction — M1 C B J H K M G F R T B C H J K G F M R T — Passes 1 and 2 correct — A1 B C H J G F K M R T B C H G F J K M R T B C G F H J K M R T B C F G H J K M R T — Sort correct — A1 Bubble sort complete — sort named correctly + 'stop' — A1 Bubble right to left J M C B T H K R G F B J M C F T H K R G — B in place, consistent direction — M1 B C J M F G T H K R B C F J M G H T K R — Passes 1 and 2 correct — A1 B C F G J M H K T R B C F G H J M K R T B C F G H J K M R T — Sort correct — A1 Bubble sort complete — sort named correctly + 'stop' — A1 **Sorting into reverse alphabetical order – this is acceptable** e.g. Quick sort middle right J M C B T H K R G F — H — M1 J M T K R H C B G F — T G T J M K R H G C B F — K B — A1 T M R K J H G C F B — R F T R M K J H G F C B — A1 Quick sort complete — A1	

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