edexcel
advancing learning, changing lives

Mark Scheme (Results)
Summer 2010

GCE

GCE Decision Mathematics D1 (6689/01)

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH

A PEARSON COMPANY

If you have any subject specific questions about the content of this Mark Scheme that require the help of a subject specialist, you may find our Ask The Expert email service helpful.

Ask The Expert can be accessed online at the following link:

http://www.edexcel.com/Aboutus/contact-us/

Summer 2010

Publications Code UA023711

edexcel

Summer 2010
Decision Mathematics D1 6689
Mark Scheme

Question Number	Scheme	Marks
Q1 (a)	<table><tr><td>H</td><td>V</td><td>L</td><td>A</td><td>N</td><td>J</td><td>S</td><td>T</td><td>P</td><td>(N)</td></tr><tr><td>H</td><td>L</td><td>A</td><td>J</td><td>N</td><td>V</td><td>S</td><td>T</td><td>P</td><td>(A, T)</td></tr><tr><td>A</td><td>H</td><td>L</td><td>J</td><td>N</td><td>S</td><td>P</td><td>T</td><td>V</td><td>(L, P)</td></tr><tr><td>A</td><td>H</td><td>J</td><td>L</td><td>N</td><td>P</td><td>S</td><td>T</td><td>V</td><td>(J)</td></tr><tr><td>A</td><td>H</td><td>J</td><td>L</td><td>N</td><td>P</td><td>S</td><td>T</td><td>V</td><td></td></tr></table>	M1 A1 A1ft A1cso **4**
(b)	1st choice $\left\lceil \frac{1+9}{2} \right\rceil = 5$ Nicky, reject 1 - 5 2nd choice $\left\lceil \frac{6+9}{2} \right\rceil = \lceil 7.5 \rceil = 8$ Tom, reject 8 - 9 3rd choice $\left\lceil \frac{6+7}{2} \right\rceil = \lceil 6.5 \rceil = 7$ Sharon, reject 7 4th choice 6 Paul name found	M1A1 A1 A1cso **4** **Total 8**

Notes:

(a) 1M1: quick sort, pivots, p, chosen and two sublists one <p one >p.

1A1: first pass correct and next pivots chosen correctly/consistently.

2A1ft: second pass correct, next pivots correctly/consistently chosen.

3A1: all correct, cso.

(b) 1M1: binary search on what they think is a alphabetical list, choosing pivot, rejecting half list.

1A1: first pass correct, condone 'sticky' pivot here, bod generous

2A1: second pass correct, pivot rejected.

3A1: cso.

Note: If incorrect list in (a) mark (b) as a misread.

Q1 Alternative solutions

Middle right

H	V	L	A	N	J	S	T	P	(N)	M1
H	L	A	J	N	V	S	T	P	(A T)	A1
A	H	L	J	N	S	P	T	V	(L P)	A1ft
A	H	J	L	N	P	S	T	V	(J)	
A	H	J	L	N	P	S	T	V		A1 cso

list sorted

Middle left

H	V	L	A	N	J	S	T	P	(N)	M1
H	L	A	J	N	V	S	T	P	(L S)	A1
H	A	J	L	N	P	S	V	T	(A V)	A1ft
A	H	J	L	N	P	S	T	V	(H)	
A	H	J	L	N	P	S	T	V		A1 cso

First

H	V	L	A	N	J	S	T	P	(H)	M1
A	H	V	L	N	J	S	T	P	(V)	A1
A	H	L	N	J	S	T	P	V	(L)	
A	H	J	L	N	S	T	P	V	(N)	A1ft
A	H	J	L	N	S	T	P	V	(S)	
A	H	J	L	N	P	S	T	V		A1 cso

Question Number	Scheme	Marks
Q2 (a)	DE GF DC $\left\{\begin{matrix}\text{not CE}\\ \text{BD}\end{matrix}\right\}$ EG (not EF not CF) AC (not AB) GH	M1 A1 A1 **3**
(b)	<table><tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td></tr><tr><td>A</td><td>-</td><td>31</td><td>30</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>B</td><td>31</td><td>-</td><td>-</td><td>24</td><td>-</td><td>-</td><td>-</td><td>38</td></tr><tr><td>C</td><td>30</td><td>-</td><td>-</td><td>22</td><td>24</td><td>29</td><td>-</td><td>-</td></tr><tr><td>D</td><td>-</td><td>24</td><td>22</td><td>-</td><td>18</td><td>-</td><td>-</td><td>34</td></tr><tr><td>E</td><td>-</td><td>-</td><td>24</td><td>18</td><td>-</td><td>28</td><td>26</td><td>-</td></tr><tr><td>F</td><td>-</td><td>-</td><td>29</td><td>-</td><td>28</td><td>-</td><td>21</td><td>-</td></tr><tr><td>G</td><td>-</td><td>-</td><td>-</td><td>-</td><td>26</td><td>21</td><td>-</td><td>33</td></tr><tr><td>H</td><td>-</td><td>38</td><td>-</td><td>34</td><td>-</td><td>-</td><td>33</td><td>-</td></tr></table>	B2, 1, 0 **2**
(c)	AC CD DE BD GE GF GH	M1 A1 A1 **3**
(d)	Weight: 174	B1 **1**
	Notes: (a) 1M1: Kruskal's algorithm – first 4 arcs selected chosen correctly. 1A1: All seven non-rejected arcs chosen correctly. 2A1: All rejections correct and in correct order and at correct time. (b) 1B1: condone two (double) errors 2B1: cao (c) 1M1: Prim's algorithm – first four arcs chosen correctly, in order, **or** first five nodes chosen correctly, in order.{A,C,D,E,B….} 1A1: First six arcs chosen correctly **or** all 8 nodes chosen correctly, in order. {A,C,D,E,B,G,F,H} 2A1: All correct and arcs chosen in correct order. (d) 1B1: cao	**Total 9**

Starting at	Minimum arcs required for M1	Nodes	order
A	AC CD DE DB	ACDEB(GFH)	15234(768)
B	BD DE DC	BDEC(GFAH)	(7)1423(658)
C	CD DE DB	CDEB(GFAH)	(7)4123(658)
D	DE DC DB	DECB(GFAH)	(7)4312(658)
E	ED DC DB	EDCB(GFAH)	(7)4321(658)
F	FG GE ED DC DB	FGEDCB(AH)	(7)654312(8)
G	GF GE ED DC DB	GFEDCB(AH)	(7)654321(8)
H	HG GF GE	HGFE(DCBA)	(8765)4321

Question Number	Scheme	Marks
Q3 (a)	e.g. total weight is 239, lower bound is $\frac{239}{60} = 3.98$ so 4 bins.	M1 A1 **2**
(b)	Bin 1 : 41 Bin 4 : 36 Bin 2 : 28 + 31 Bin 5 : 32 Bin 3 : 42 Bin 6: 29	M1 A1 A1 **3**
(c)	Full Bins : 28 + 32 31 + 29 The other 3 items (42, 41, 36) require 3 separate bins	M1 A1 **2**
(d)	There are 5 items over 30. No two of these 5 can be paired in a bin, so at least 5 bins will be required.	B2, 1, 0 **2**
		Total 9

Notes:

(a) 1M1: Any correct statement, must involve calculation
1A1: cao (accept 4 for both marks)

(b) 1M1: Bins 1 and 2 correct and at least 6 values put in bins
1A1: Bins 1,2,3 and 4 correct.
2A1: All correct

(c) 1M1: Attempt to find two full bins and allocate at least 6 values
1A1: cao

(d) 1B1: Correct argument may be imprecise or muddled (bod gets B1)
2B1: A good, clear, correct argument.(They have answered the question 'why?')

Misread in (b) First Fit Decreasing

Bin 1: 42 Bin 2: 41 Bin 3: 36 Bin 4: 32 28 Bin 5: 31 29
(Remove up to two A marks if earned – so M1 max in (b) if first 4 bins correct.)

Question Number	Scheme	Marks
Q4		
(a)	BC + EG = 10.4 + 10.1 = 20.5 smallest	M1 A1
	BE + CG = 8.3 + 16.1 = 24.4	A1
	BG + CE = 14.9 + 11.9 = 26.8	A1
	So repeat tunnels BA, AC and EG	A1
		5
(b)	Any route e.g. ACFGDCABDEGEBA	B1
	Length = 73.3 + their 20.5 = 93.8km	M1 A1
		3
(c)	The new tunnel would make C and G even.	
	So only BE would need to be repeated.	B1
	Extra distance would be 10 + 8.3 = 18.3 < 20.5 [91.6 < 93.8]	
	So it would decrease the total distance.	DB1
		2
		Total 10

Notes:

(a) 1M1: Three pairings of their four odd nodes
1A1: one row correct
2A1: two rows correct
3A1: all correct
4A1: correct **arcs** identified

(b) 1B1: Any correct route (14 nodes)
1M1: 73.3 + ft their least, from a choice of at least two.
1A1: cao

(c) 1B1: A correct explanation, referring to BE and relevant numbers (8.3, 12.2, 2.2, 18.3,81.3, 91.6) maybe confused, incomplete or lack conclusion –bod gets B1
2B1D: A correct, clear explanation all there + conclusion (ft on their numbers.)

Question Number	Scheme	Marks
Q5	e.g.	
(a)	G – 3 = E – 2 = A – 4 = S – 6	M1
	Change status G = 3 – E = 2 – A = 4 – S = 6	A1
	Improved matching	A1
	A = 4 (C unmatched) E = 2 G = 3 J = 5 S = 6	**3**
(b)	e.g. Both C and J can only be matched to 5 Both 1 and 6 can only be done by S	B2, 1, 0 **2**
(c)	C – 5 = J – 4 = A – 2 = E – 6 = S – 1	M1
	Change status C = 5 – J = 4 – A = 2 – E = 6 – S = 1	A1
	Complete matching	
	A = 2 C = 5 E = 6 G = 3 J = 4 S = 1	A1
		3
		Total 8

Notes:

(a) 1M1: Path from G to 6 or 1
1A1: CAO including change status (stated or shown), chosen path clear.
2A1: CAO must ft from stated path, diagram ok

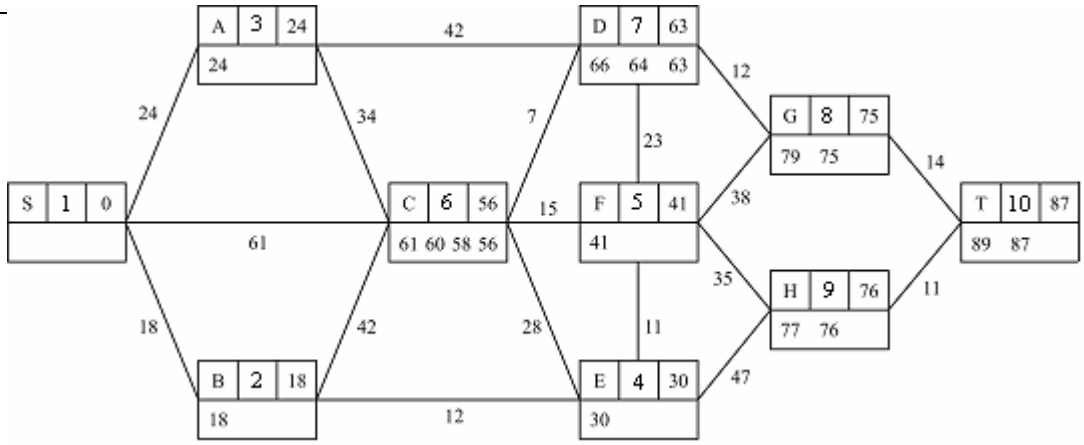
(b) 1B1: Correct answer, may be imprecise or muddled (bod gets B1)
all relevant nodes should be referred to and must be correct, but condone one (genuine) slip.
2B1: Good, clear, correct answer.

(c) 1M1: Path from C to 1 or 6 [whichever they didn't use before.]
1A1: CAO including change status (stated or shown), chosen path clear. (Don't penalise change status twice.)
2A1: CAO must ft from stated path, diagram ok

Alt

(a) G – 3 = E – 2 = A – 4 = S – 1 c.s. G = 3 – E = 2 – A = 4 – S = 1
A = 4, (C unmatched), E = 2, G = 3, J = 5, S = 1

(c) C – 5 = J – 4 = A – 2 = E – 6 c.s. C = 5 – J = 4 – A = 2 – E = 6
A = 2, C = 5, E = 6, G = 3, J = 4, S = 1

Question Number	Scheme	Marks
Q6 (a)		M1 A1 A1ft A1
	Route: SBEFHT Time: 87 minutes	B1 B1ft **6**
(b)	Accept demonstration of relevant subtractions, or general explanation.	B2ft,1ft, 0 **2**
(c)	Route: EFHT	B1 **1**
		Total 9

Notes:

(a) 1M1: Smaller number replacing larger number in the working values at C or D or G or H or T. (generous – give bod)

1A1: All values in boxes S, A, B, E and F correct

2A1ft: All values in boxes C and D (ft) correct. Penalise order of labelling errors just once.

3A1: All values in boxes G, H and T correct

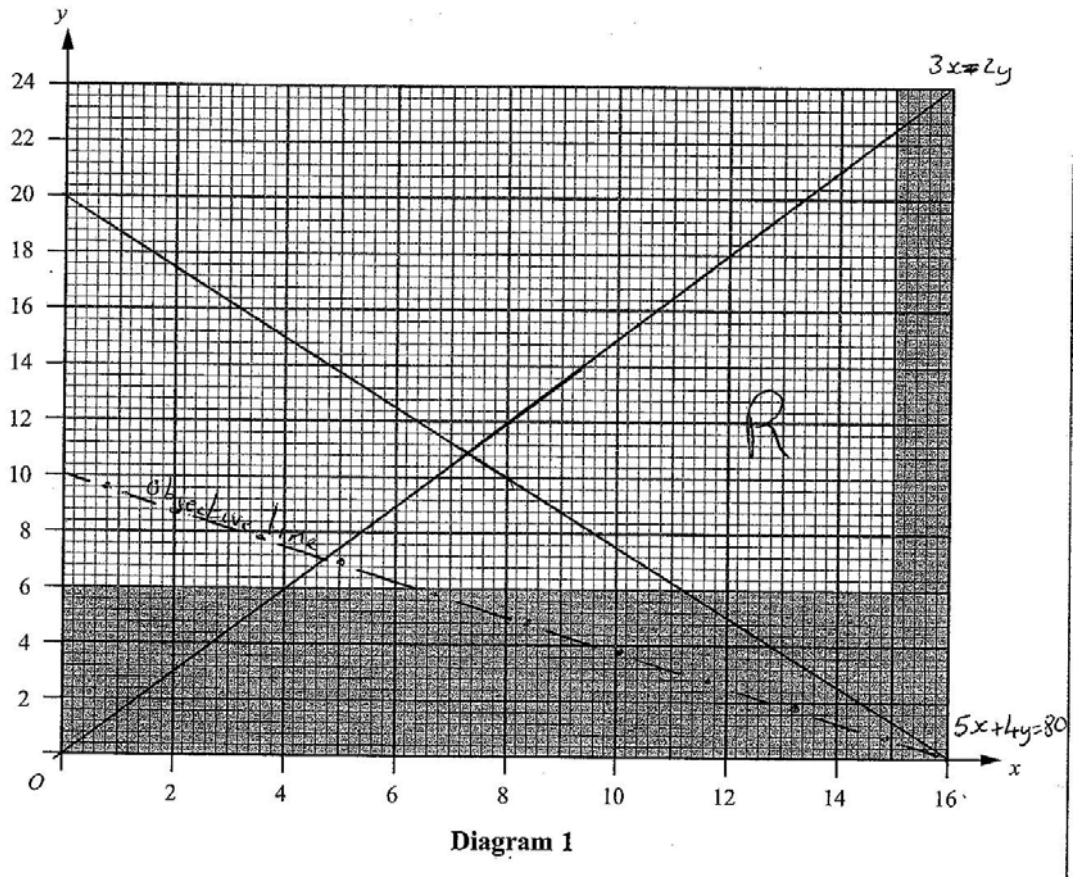
1B1: CAO (not ft)

2B1ft: Follow through from their T value, condone lack of units here.

(b) 1B1ft: Partially complete account, maybe muddled, bod gets B1

2B1ft: Complete, clear account.

(c) 1B1: CAO

Question Number	Scheme	Marks
Q7		
(a)	To indicate the strict inequality	B1 **1**
(b)	$3x = 2y$ and $5x + 4y = 80$ added to the diagram. R correctly labelled.  **Diagram 1**	B1, B1 B1 **3**
(c)	[Minimise C =] $500x + 800y$	B1, B1 **2**
(d)	Point testing or Profit line Seeking integer solutions (11, 7) at a cost of £ 11 100.	M1 A1 M1 B1, B1 **5** **Total 11**

Notes:

(a) 1B1: CAO

(b) 1B1: $3x = 2y$ passing through 1 small square of (0,0) and (12, 18), but must reach x = 15

2B1: $5x + 4y = 80$ passing through 1 small square of (0, 20) and (16, 0) (extended if necessary) but must reach y = 6

3B1: R CAO (condoning slight line inaccuracy as above.)

(c) 1B1: Accept expression and swapped coefficients. Accept 5x + 8y for 1 mark

2B1: CAO (expression still ok here)

(d) 1M1: Profit line [gradient accept reciprocal, minimum length line passes through (0, 2.5) (4, 0)] **OR** testing 2 points in their FR near two different vertices.

1A1: Correct profit line **OR** 2 points correctly tested in correct FR (my points)

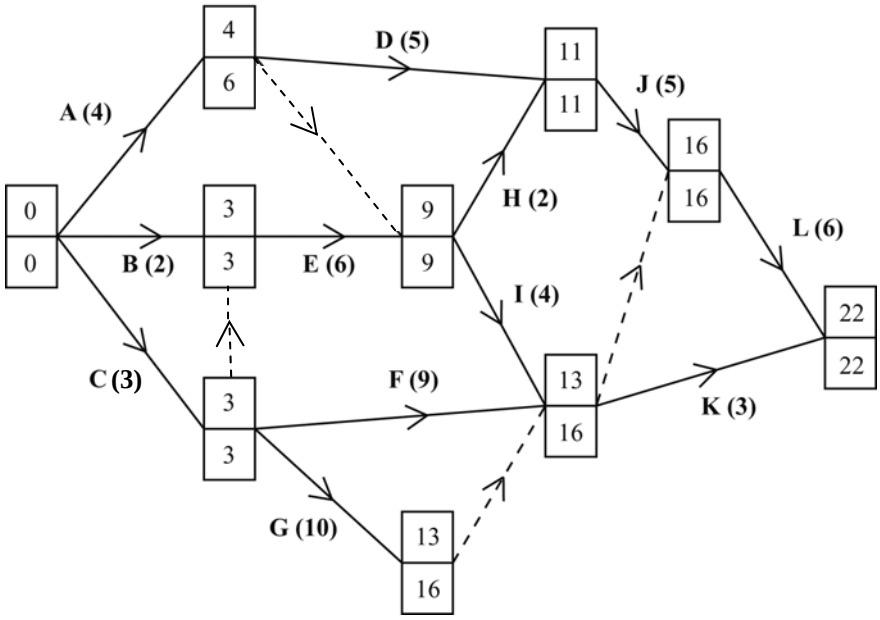
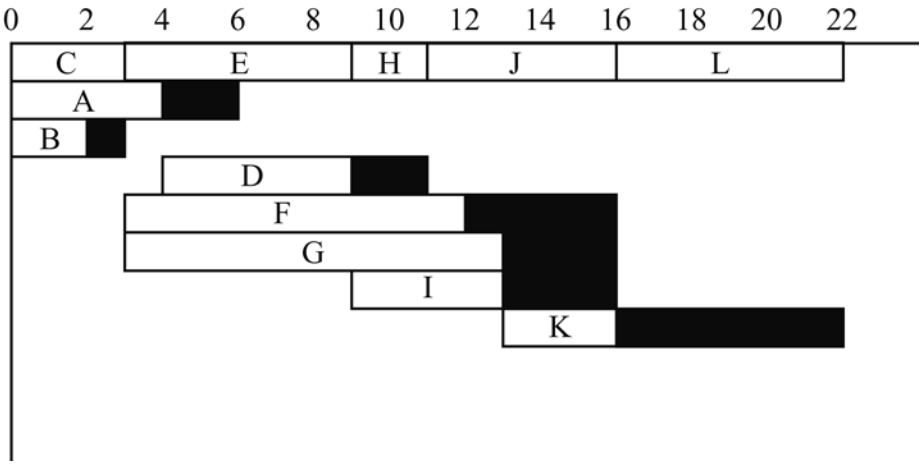
e.g

$(7\frac{3}{11}, 10\frac{10}{11}) = 12\,363\frac{7}{11}$	or	$(7,11) = 12\,300$
		$(8,10) = 12\,000$
		$(8,11) = 12\,800$
$(11\frac{1}{5}, 6) = 10\,400$	or	$(11,6) = 10\,300$
$(15,6) = 12\,300$	or	$(15,7) = 13\,100$
$(15, 22\frac{1}{2}) = 25\,500$	or	$(15,22) = 25\,100$
$(11,7) = 11\,100$		

2M1: Seeking integer solution in correct FR (so therefore no y = 6 points)

1B1: (11,7) CAO

2B1: £11 100 CAO

Question Number	Scheme	Marks
Q8 (a)		M1 A1 M1 A1 **4**
(b)	Critical activities: C E H J L	B1 **1**
(c)		M1 A1 A1 A1 **4**
(d)	4 workers needed e.g. at time 8 ½ (noon on day 9) activities E, D, F and G must be happening.	B2, 1, 0 **2**
		Total 11

Notes for Q8

(a) 1M1: Top boxes completed generally increasing left to right.
1A1: CAO.
2M1: Bottom boxes completed generally decreasing right to left.
2A1: CAO.

(b) 1B1: Critical activities cao.

(c) 1M1: At least 10 activities placed, at least five floats. Scheduling diagram gets M0.
1A1: my critical activities correct.
2A1: condone one error on my non-critical activities.
3A1: my non-critical activities correct.

(d) 1B1: A correct statement, details of either time (7<time<9, 8<day<10), or activities, bod gets B1. Allow 1 B mark (only) on ft from their 12 activity, 7 float diagram.
2B1: A correct, complete full statement details of time and activities.

Further copies of this publication are available from
Edexcel Publications, Adamsway, Mansfield, Notts, NG18 4FN

Telephone 01623 467467
Fax 01623 450481

Email publications@linneydirect.com

Order Code UA023711 Summer 2010

For more information on Edexcel qualifications, please visit www.edexcel.com/quals

Edexcel Limited. Registered in England and Wales no.4496750
Registered Office: One90 High Holborn, London, WC1V 7BH