edexcel
advancing learning, changing lives

Mark Scheme (Results)
January 2010

GCE

Decision Mathematics D1 (6689)

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

A PEARSON COMPANY

Edexcel is one of the leading examining and awarding bodies in the UK and throughout the world. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers.

Through a network of UK and overseas offices, Edexcel's centres receive the support they need to help them deliver their education and training programmes to learners.

For further information, please call our GCE line on 0844 576 0025, our GCSE team on 0844 576 0027, or visit our website at www.edexcel.com.

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.

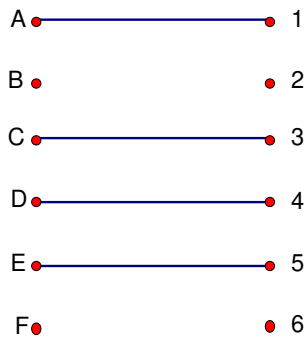
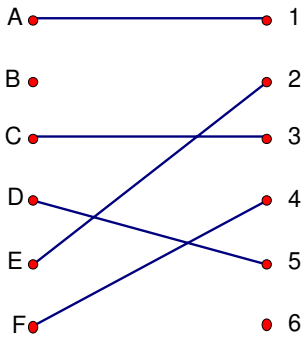
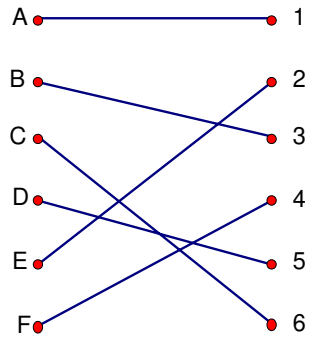
Ask The Expert can be accessed online at the following link:

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

January 2010

Publications Code UA022719

January 2010
6689 Decision Mathematics D1
Mark Scheme

Question Number	Scheme	Marks
Q1(a)	 Initial map	B1 (1)
Q1(b)	  E.g. Path 1 F-4-D-5-E-2 Path 2 B-3-C-6 Matching A : 1, B : 3, C : 6, D : 5, E : 2, F : 4	M1 A1 M1 A1 A1 (5) [6]

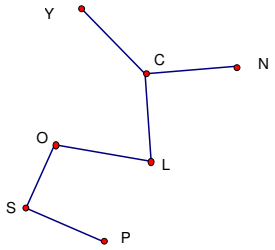
Question Number	Scheme	Marks
Q1(b)		

Question 1(b) Alternative Solutions

	Path 1	Path 2	Matching					
			A	B	C	D	E	F
1	B-3-C-1-A-2	F-3-B-4-D-5-E-1-C-6	2	4	6	5	1	3
2	B-3-C-1-A-2	F-3-B-4-D-5-E-2-A-1-C-6	1	4	6	5	2	3
3	B-3-C-1-A-2	F-4-D-5-E-1-C-6	2	3	6	5	1	4
4	B-3-C-1-A-2	F-4-D-5-E-2-A-1-C-6	1	3	6	5	2	4
5	B-3-C-4-D-5-E-1-A-2	F-3-B-4-C-6	2	4	6	5	1	3
6	B-3-C-4-D-5-E-1-A-2	F-4-C-6	2	3	6	5	1	4
7	B-3-C-6	F-3-B-4-D-5-E-1-A-2	2	4	6	5	1	3
8	B-3-C-6	F-3-B-4-D-5-E-2	1	4	6	5	2	3
9	B-3-C-6	F-4-D-5-E-1-A-2	2	3	6	5	1	4
10	B-3-C-6	F-4-D-5-E-2	1	3	6	5	2	4
11	B-4-D-5-E-2	F-3-C-6	1	4	6	5	2	3
12	B-4-D-5-E-2	F-4-B-3-C-6	1	3	6	5	2	4
13	B-4-D-5-E-1-A-2	F-3-C-6	2	4	6	5	1	3
14	B-4-D-5-E-1-A-2	F-4-B-3-C-6	2	3	6	5	1	4
15	F-3-C-1-A-2	B-3-F-4-D-5-E-1-C-6	2	3	6	5	1	4
16	F-3-C-1-A-2	B-3-F-4-D-5-E-2-A-1-C-6	1	3	6	5	2	4
17	F-3-C-1-A-2	B-4-D-5-E-1-C-6	2	4	6	5	1	3
18	F-3-C-1-A-2	B-4-D-5-E-2-A-1-C-6	1	4	6	5	2	3
19	F-3-C-4-D-5-E-1-A-2	B-3-F-4-C-6	2	3	6	5	1	4
20	F-3-C-4-D-5-E-1-A-2	B-4-C-6	2	4	6	5	1	3
21	F-3-C-6	B-3-F-4-D-5-E-1-A-2	2	3	6	5	1	4
22	F-3-C-6	B-3-F-4-D-5-E-2	1	3	6	5	2	4
23	F-3-C-6	B-4-D-5-E-1-A-2	2	4	6	5	1	3
24	F-3-C-6	B-4-D-5-E-2	1	4	6	5	2	3
25	F-4-D-5-E-2	B-3-C-6	1	3	6	5	2	4
26	F-4-D-5-E-2	B-4-F-3-C-6	1	4	6	5	2	3
27	F-4-D-5-E-1-A-2	B-3-C-6	2	3	6	5	1	4
28	F-4-D-5-E-1-A-2	B-4-F-3-C-6	2	4	6	5	1	3

Notes

(a) B1 cao preferably just 4 lines, but accept if unambiguous.
(b) M1 attempt at a path from B or F to 2 or 6
A1 correct path – including change status
M1 attempt at a second path from F or B to 6 or 2
A1 correct path – including change status (do not penalise change status twice)
A1 correct matching; must follow from 2 correct paths

Question Number	Scheme	Marks
Q2(a)	(i) **All pairs** of vertices connected by a **path**, but not describing complete graph. (ii) No cycles (iii) All nodes connected (accept definition of **minimum** spanning tree)	B1 B1 B1 (3)
Q2(b)	Kruskal's (algorithm)	B1 (1)
Q2(c)(i)	L-O 56 Using Prim. first 2 correct L-C 60 C-N 62 O-S 63 Next 2 S-P 43 C-Y 156 Finish Total length 440 (miles) Total	M1 A1 A1 A1 =B1
Q2(c)(ii)	Tree correct 	B1 (5) [9]

Q2(c)

Accept weights as indicating arcs.

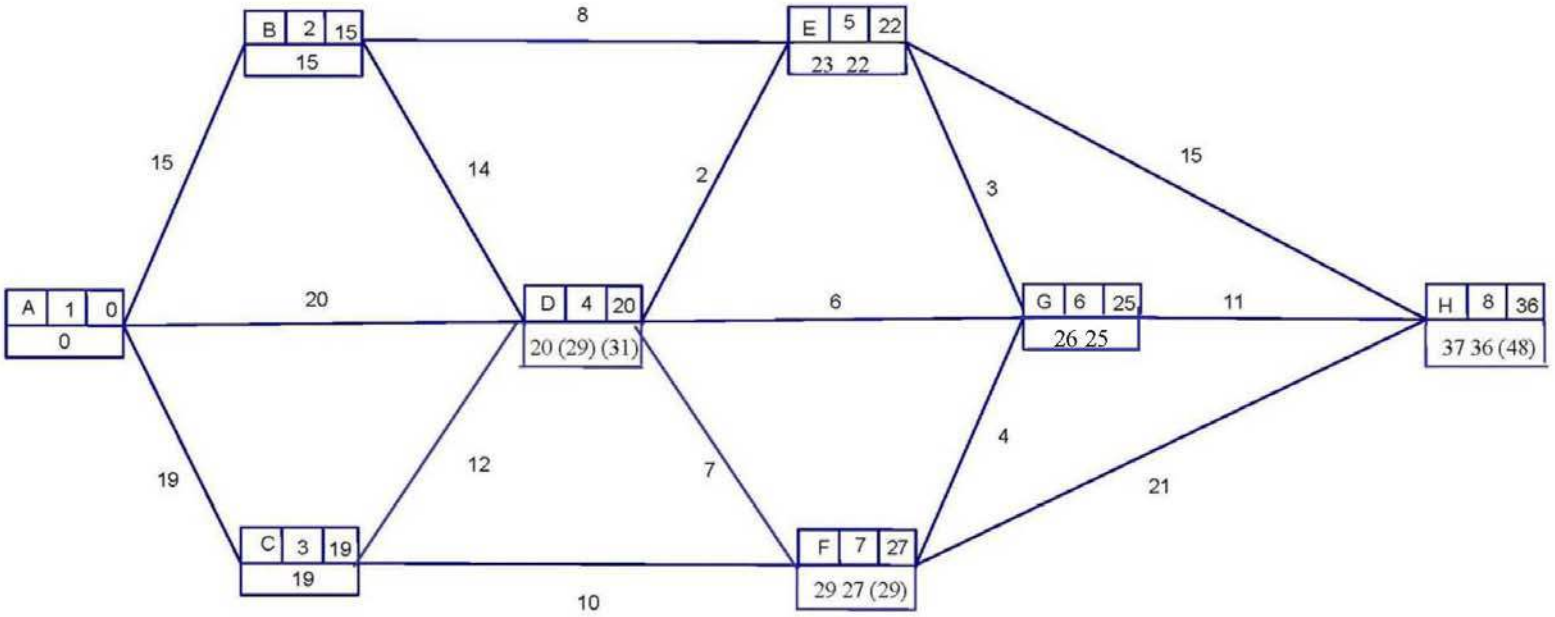
Misreads – award M1 A0 A0 for these:

- Vertices, not edges given L O C N S P Y
- Numbers across top, edges either incorrect or not given: 3 1 4 2 6 5 7.

Also accept these, misreading And not starting at L – again M1A0A0

Started at	Minimum arcs	nodes	Numbers
C	CL,LO,CN,…..	CLONSPY	1243657
N	NC,CL,LO,OS,SP,CY	NCLOSPY	2314657
O	OL,LC,CN,OS,….	OLCNSPY	3241657
P	PS,SO,OL,LC,CN.CY	PSOLCNY	5463127
S	SP.SO,…	SPOLCNY	5463217
Y	YC,CL,LO,CN,..	YCLONSP	2354761

Q3(a)



Clear method to include at least 1 update (look at E, F, G or H)	M1	
BCDE correct	A1	
FGH correct	A1ft	
Route ADEGH	A1	
Total time 36 Minutes	A1ft	(5)

Question Number	Scheme	Marks
Q3(b)	Odd nodes are A, B, C, H	M1
	AB + CH = 15 + 25 = 40	A1
	AC + BH = 19 + 22 = 41	A1
	AH + BC = 36 + 22 = 58	A1
	(40 is the shortest, repeating AB and CF + FG + GH)	
	Must be choosing from at least two pairings for this last mark	
	Shortest time = 167 + 40 = 207 minutes. 167 + their shortest	A1ft (5)
		[10]

Question Number	Scheme											Marks
Q4(a)	0.6	4.0	2.5	3.2	0.5	**2.6**	0.4	0.3	4.0	1.0	**2.6**	
	4.0	**3.2**	4.0	2.6	0.6	2.5	0.5	**0.4**	0.3	1.0	**3.2 0.4**	M1
	4.0	**4.0**	3.2	2.6	0.6	2.5	**0.5**	1.0	0.4	**0.3**	**4.0 0.5**	A1
	4.0	4.0	3.2	2.6	0.6	**2.5**	1.0	0.5	0.4	0.3	**2.5**	A1ft
	4.0	4.0	3.2	2.6	2.5	0.6	**1.0**	0.5	0.4	0.3	**1.0**	A1ft
	4.0	4.0	3.2	2.6	2.5	1.0	**0.6**	0.5	0.4	0.3		A1 cso (5)
Q4(b)	Length 1: 4 Length 2: 4 Length 3: 3.2 0.6 left column & 1.0 in place Length 4: 2.6 1.0 0.4 0.6 & 0.5 Length 5: 2.5 0.5 0.3 0.4 All correct (c.s.o)											M1 A1 A1 A1 (4)
Q4(c)	19.1/4 = 4.775 so 5 lengths needed, accept total is 19.1m, or refer to 0.9 'spare . Yes, the answer to (b) does use the minimum number of bins.											B1 DB1 (2) [11]

Notes for Q4(a)

1M1 Pivot, p, chosen. List sorted, >p, p. <p or <p, p, >p. **If only choosing 1 pivot per iteration M1 only**
1A1 1st pass correct and chosen next **two** pivots correctly for sublists >1
2A1ft 2nd pass correct and chosen next **two** pivots correctly for sublists >1
3A1ft 3rd pass correct and next pivot for sublist >1 chosen correctly.
4A1 cso.

Misread in part (a)

- If they have misread a number **at the start of part (a), so genuinely miscopied** and got for example 0.1 instead of 1.0 then mark the whole question as a misread – removing the last two A or B marks earned. This gives a maximum total of 9.

- If they misread their own numbers **during the course of part (a)** then count it as an **error in part (a)** but mark parts (b) and (c) as a misread. So they would lose marks in (a) for the error and then the last two A or B marks earned in (b) and (c) - giving a maximum of 8 or maybe 7 marks depending on how many marks they lose in (a).

The most popular misread is the one listed above – where 1.0 has changed to 0.1 giving
4.0 4.0 3.2 2.6 2.5 0.6 0.5 0.4 0.3 **0.1** at the end of (a) for this one (b) and (c) are:

(b) Length 1: 4
Length 2: 4
Length 3: 3.2 0.6 0.1
Length 4: 2.6 0.5 0.4 0.3
Length 5: 2.5

(c) 18.2/4 = 4.55 so 5 bins, or total is 18.2 or 1.8 'spare'
Yes answer in (b) uses the minimum number of bins.

Alternate solutions for Question 4

Choosing middle left

0.6	4.0	2.5	3.2	0.5	2.6	0.4	0.3	4.0	1.0	(pivot 0.5)
0.6	4.0	2.5	3.2	2.6	4.0	1.0	**0.5**	0.4	0.3	(pivots 3.2, 0.4)
4.0	4.0	**3.2**	0.6	2.5	2.6	1.0	**0.5**	**0.4**	0.3	(pivots 4.0, 2.5)
4.0	4.0	**3.2**	2.6	**2.5**	0.6	1.0	**0.5**	**0.4**	**0.3**	(pivots 0.6)
4.0	**4.0**	**3.2**	**2.6**	**2.5**	1.0	**0.6**	**0.5**	**0.4**	**0.3**	
4.0	**4.0**	**3.2**	**2.6**	**2.5**	**1.0**	**0.6**	**0.5**	**0.4**	**0.3**	

Choosing first

0.6	4.0	2.5	3.2	0.5	2.6	0.4	0.3	4.0	1.0	(pivot 0.6)
4.0	2.5	3.2	2.6	4.0	1.0	**0.6**	0.5	0.4	0.3	(pivots 4.0, 0.5)
4.0	2.5	3.2	2.6	4.0	1.0	**0.6**	**0.5**	0.4	0.3	(pivots 2.5, 0.4)
4.0	3.2	2.6	4.0	**2.5**	1.0	**0.6**	**0.5**	**0.4**	0.3	(pivots 3.2)
4.0	4.0	**3.2**	2.6	**2.5**	**1.0**	**0.6**	**0.5**	**0.4**	**0.3**	
4.0	**4.0**	**3.2**	**2.6**	**2.5**	**1.0**	**0.6**	**0.5**	**0.4**	**0.3**	

OR (alternate choosing first)

0.6	4.0	2.5	3.2	0.5	2.6	0.4	0.3	4.0	1.0	(pivot 0.6)
4.0	2.5	3.2	2.6	4.0	1.0	**0.6**	0.5	0.4	0.3	(pivots 4.0, 0.5)
4.0	**4.0**	2.5	3.2	2.6	1.0	**0.6**	**0.5**	0.4	0.3	(pivots 2.5, 0.4)
4.0	**4.0**	3.2	2.6	**2.5**	1.0	**0.6**	**0.5**	**0.4**	0.3	(pivots 3.2)
4.0	**4.0**	**3.2**	2.6	**2.5**	**1.0**	**0.6**	**0.5**	**0.4**	**0.3**	
4.0	**4.0**	**3.2**	**2.6**	**2.5**	**1.0**	**0.6**	**0.5**	**0.4**	**0.3**	

Question 4 sorting into ASCENDING order (full marks if then reversed, otherwise MISREAD)

Middle left

0.6	4.0	2.5	3.2	0.5	2.6	0.4	0.3	4.0	1.0	(pivot 0.5)
0.4	0.3	**0.5**	0.6	4.0	2.5	3.2	2.6	4.0	1.0	(pivot 0.4, 3.2)
0.3	**0.4**	**0.5**	0.6	2.5	2.6	1.0	**3.2**	4.0	4.0	(pivot 2.5, 4.0)
0.3	**0.4**	**0.5**	0.6	1.0	**2.5**	2.6	**3.2**	**4.0**	4.0	(pivot 0.6)
0.3	**0.4**	**0.5**	**0.6**	1.0	**2.5**	**2.6**	**3.2**	**4.0**	**4.0**	

Middle right

0.6	4.0	2.5	3.2	0.5	2.6	0.4	0.3	4.0	1.0	(pivot 2.6)
0.6	2.5	0.5	0.4	0.3	1.0	**2.6**	4.0	3.2	4.0	(pivot 0.4, 3.2)
0.3	**0.4**	0.6	2.5	0.5	1.0	**2.6**	**3.2**	4.0	4.0	(pivot 0.5, 4.0)
0.3	**0.4**	**0.5**	0.6	2.5	1.0	**2.6**	**3.2**	4.0	**4.0**	(pivot 2.5)
0.3	**0.4**	**0.5**	0.6	1.0	**2.5**	**2.6**	**3.2**	4.0	**4.0**	(pivot 1.0)

First (1)

0.6	4.0	2.5	3.2	0.5	2.6	0.4	0.3	4.0	1.0	(pivot 0.6)
0.5	0.4	0.3	**0.6**	4.0	2.5	3.2	2.6	4.0	1.0	(pivot 0.5, 4.0)
0.4	0.3	**0.5**	**0.6**	2.5	3.2	2.6	1.0	**4.0**	4.0	(pivots 0.4, 2.5)
0.3	**0.4**	**0.5**	**0.6**	1.0	**2.5**	3.2	2.6	**4.0**	**4.0**	(pivots 3.2)
0.3	**0.4**	**0.5**	**0.6**	**1.0**	**2.5**	2.6	**3.2**	**4.0**	**4.0**	

First (2)

0.6	4.0	2.5	3.2	0.5	2.6	0.4	0.3	4.0	1.0	(pivot 0.6)
0.5	0.4	0.3	**0.6**	4.0	2.5	3.2	2.6	4.0	1.0	(pivot 0.5, 4.0)
0.4	0.3	**0.5**	**0.6**	2.5	3.2	2.6	1.0	4.0	**4.0**	(pivots 0.4, 2.5)
0.3	**0.4**	**0.5**	**0.6**	1.0	**2.5**	3.2	2.6	4.0	**4.0**	(pivots 3.2)
0.3	**0.4**	**0.5**	**0.6**	**1.0**	**2.5**	2.6	**3.2**	4.0	**4.0**	

Question Number	Scheme	Marks
Q5		
(a)		

S	T	R	R>0?	Output	
25000	0	17000	y		Line 1
	3400				Line 2
		7000			Line 3
			y		Line 4
	4450				Line 5
		-5000			Line 6
			n		Line 7
				4450	

Lines 1 & 2: M1A1
Lines 3-7: M1A1

Output correct: A1

(5)

(b) Tax on £25 000 is £4450 B1ft

(1)

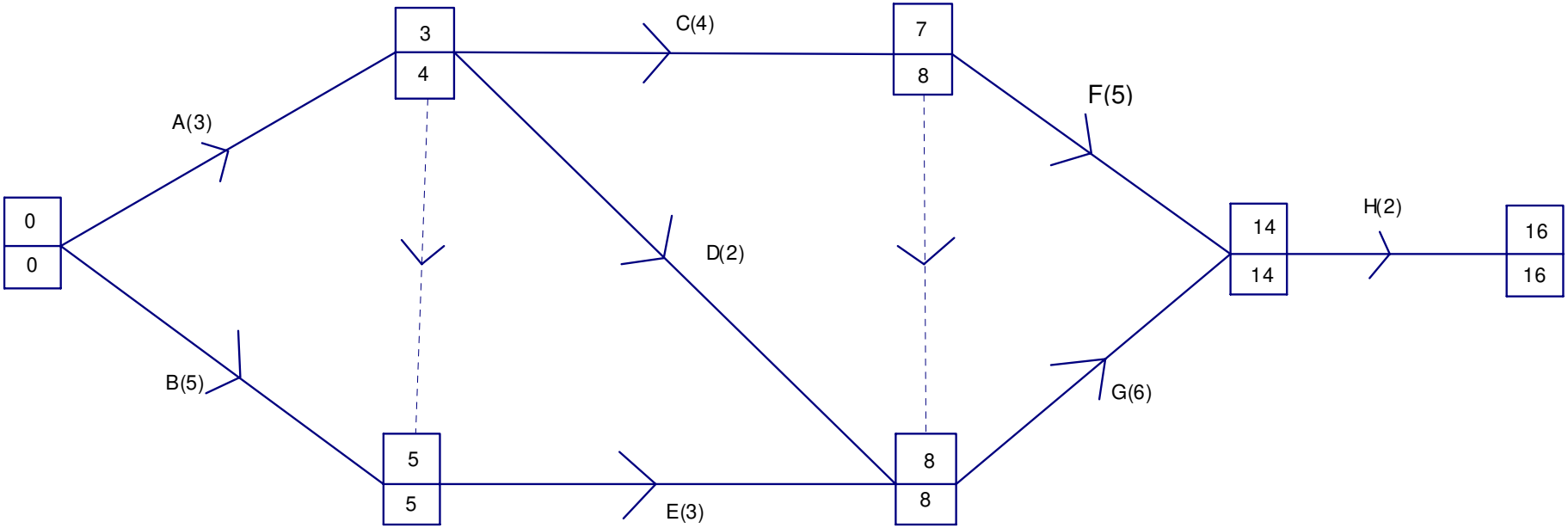
(c) Tax free sum = £8000: B1

(1)

[7]

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>Q6(a)</td><td>The dotted line represents a dummy activity.
It is necessary because C and D depend only on A, but E depends on A and B.</td><td>B1
B1
(2)</td></tr>
<tr><td>Q6(b)</td><td>
<table>
<tr><th>Activity</th><th>Immediately preceding activity</th></tr>
<tr><td>A</td><td>-</td></tr>
<tr><td>B</td><td>-</td></tr>
<tr><td>C</td><td>A</td></tr>
<tr><td>D</td><td>A</td></tr>
<tr><td>E</td><td>A,B</td></tr>
<tr><td>F</td><td>C (A)</td></tr>
<tr><td>G</td><td>C, D, E</td></tr>
<tr><td>H</td><td>F, G</td></tr>
</table>
To this point
For E & F, accepting correct “extra”
Last two rows, correct only,
</td><td>B1
B1
B1
(3)</td></tr>
</table>

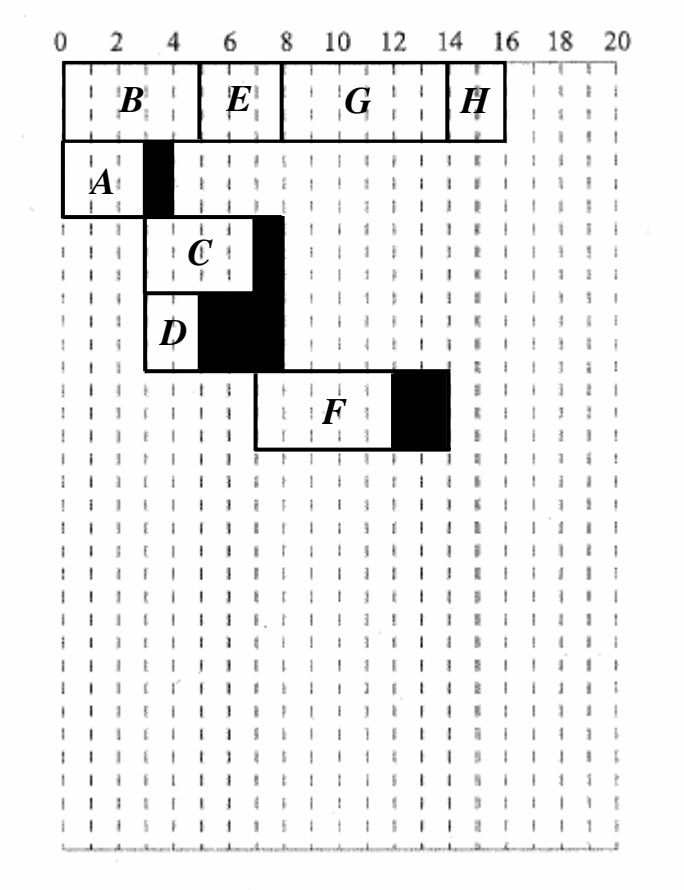
Q6(c)

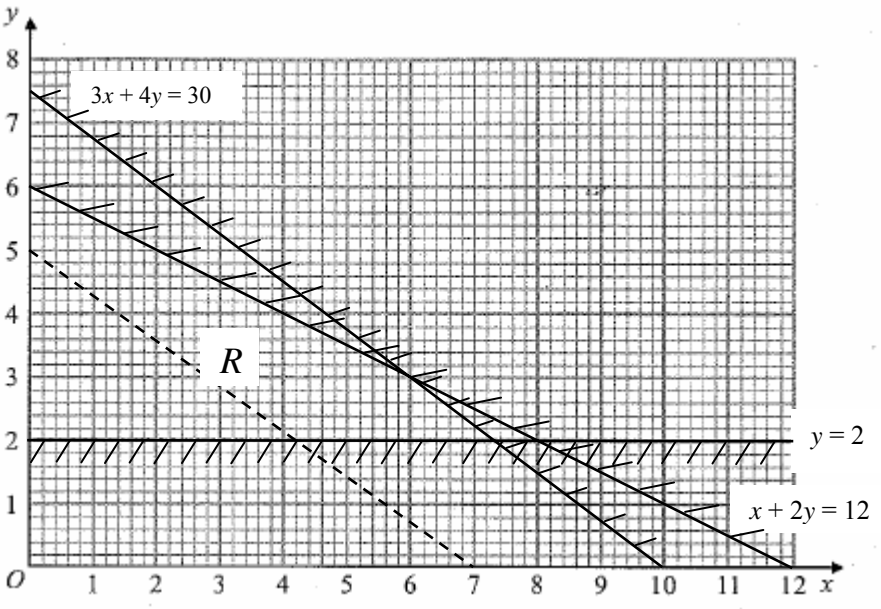


Early times	M1A1	
Late times	M1A1	(4)

Q6(d) Critical activities: B, E, G, H — B1

Critical path: 16 days — B1ft (2)

Question Number	Scheme	Marks
Q6(e)		
	At least 6 activities placed including at least 3 floats	M1
	Critical Activities	A1
	A + C	A1
	D + F	A1
		(4)
		[15]

Question Number	Scheme	Marks
Q7(a)	$x + 2y \leq 12$ $(150x + 300y \leq 1800)$	M1A1 (2)
Q7(b)	$0.9x + 1.2y \leq 9$ $\rightarrow 3x + 4y \leq 30$ (*)	M1 A1 cso (2)
Q7(c)	(You need to buy) at least 2 large cupboards.	B1 (1)
Q7(d)	Capacity C and 140%C So total is $Cx + \frac{140}{100}Cy$ Simplify to $7y + 5x$ (*)	 M1 A1cso (2)
Q7(e)	 Graph: $y \geq 2$ $0.9x + 1.2y \leq 12$ $(3x + 4y \leq 30)$ $x + 2y \leq 12$ $(150x + 300y \leq 1800)$ Lines labelled & drawn with a ruler Shading, Region identified	 B1 B1 B1 B1 B1, B1 (6)
Q7(f)	Consider points and value of $5x + 7y$: Or draw a clear profit line (7,2) → 49 or (7 ⅓,2) → 50 ⅔, or (7.3, 2) → 50.5 (6,3) → 51 (0,6) → 42 (0,2) → 14 Best option is to buy 6 standard cupboards and 3 large cupboards.	M1A1 A1 A1 (4)
		[17]

Question 7 notes

(a) 1M1 – correct terms, accept = here, accept swapped coefficients.
1A1 – cao does not need to be simplified.

(b) 1M1 – correct terms, must deal with cm/m correctly, accept = here.
1A1 – cso **answer given**.

(c) 1B1 – cao 'at least' and '2' and 'large'.

(d) 1M1 – '1.4' or '5 x 40%'maybe '5+2' seen, they **must** be **seen** to engage with 140% in some way.
1A1 – cso **answer given.**

Lines should be within 1 small square of correct point at axes.

(e) 1B1 – correctly drawing y = 2.
2B1 – correctly drawing $3x + 4y = 30$ [$0.9x + 1.2y = 12$]
3B1 – correctly drawing $x + 2y = 12$ [$150x + 300y = 1800$], **ft only** if swapped coefficients in (a) (6,0) (2,8).

These next 3 marks are only available for candidates who have drawn at least 2 lines, including at least one 'diagonal' line with negative gradient.

4B1 – Ruler used. At least 2 lines labelled including one 'diagonal' line.
5B1 – Shading, or R correct, b.o.d. on their lines.
6B1 – all lines and R correct.

(f) 1M1 At least 2 points tested **or** objective line drawn with correct m or 1/m, minimum intercepts 3.5 and 2.5.
1A1 – 2 points correctly tested **or** objective line correct.
2A1 – 3 points correctly tested **or** objective line correct and distinct/labelled.
3A1 – 6 standard and 3 large, accept (6,3) if very clearly selected in some way.

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 UA022719 January 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