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Mark Scheme (Results)
January 2010

GCE

Decision Mathematics D1 (6689)

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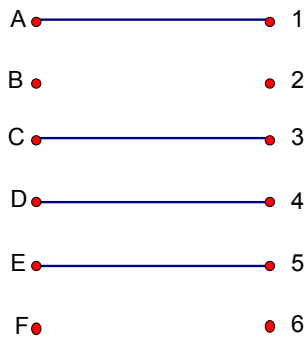
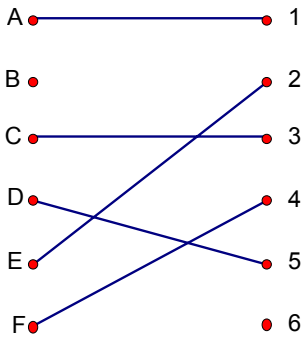
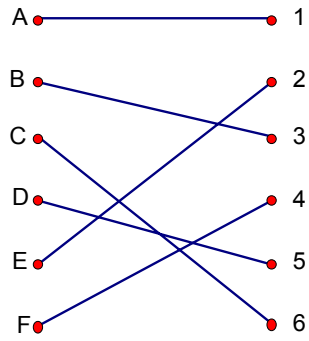
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January 2010

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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]**

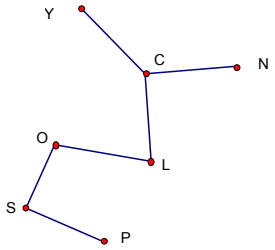
Question Number	Scheme	Marks
Q1(b)		

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.

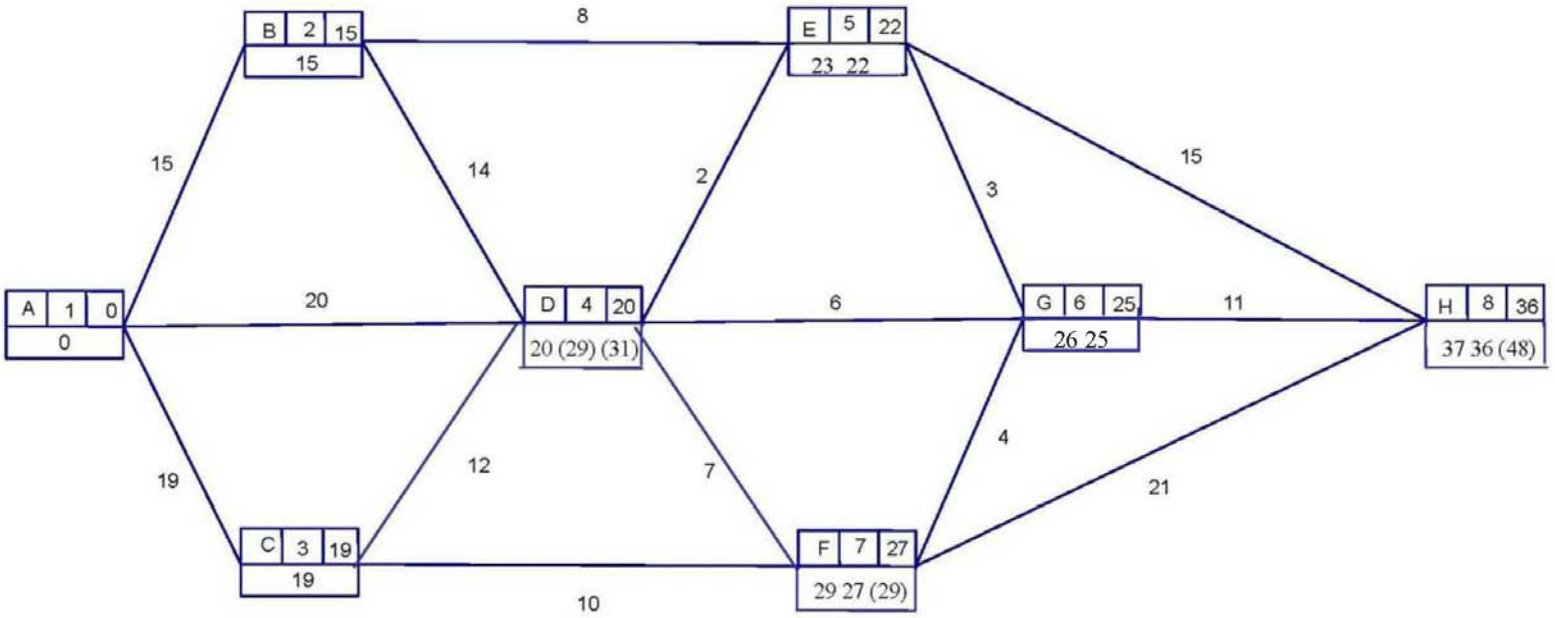
Misreads – award M1 A0 A0 for these:

- 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)

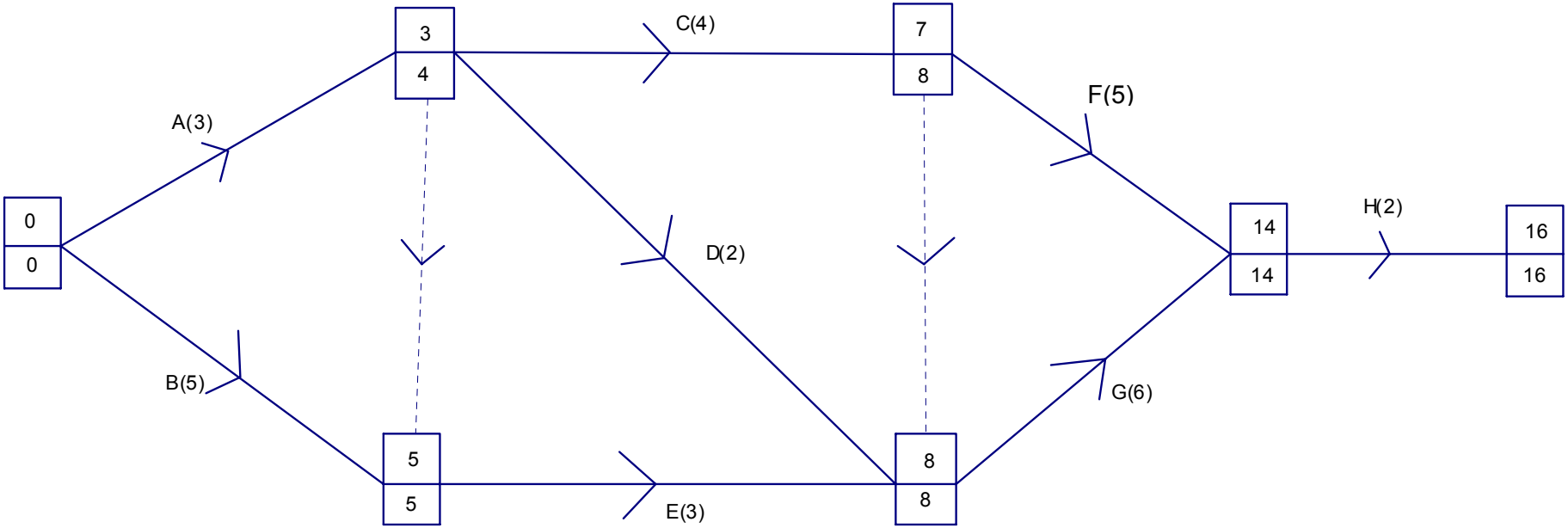
(c) Tax free sum = £8000: B1

(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>

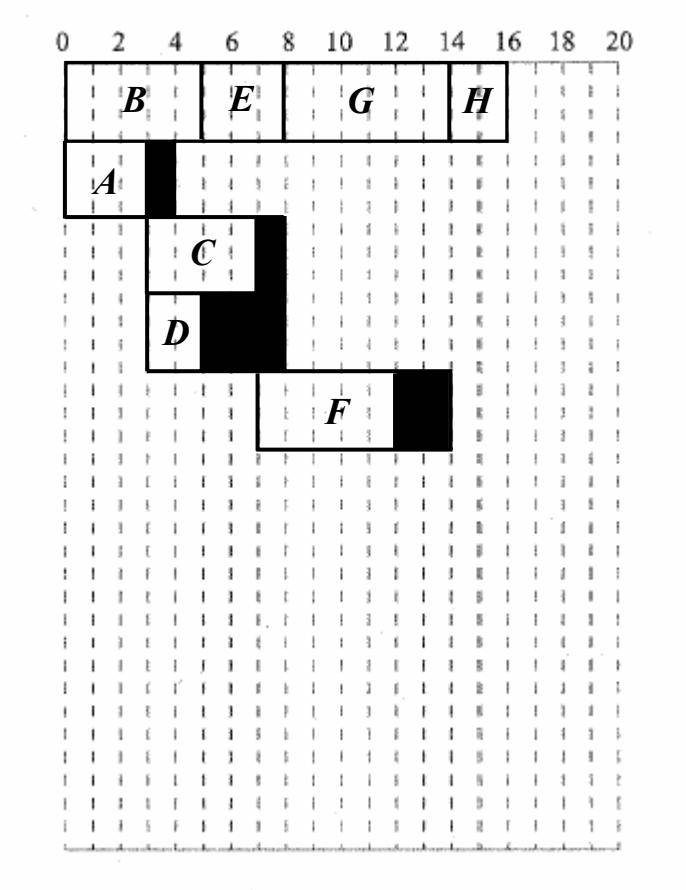
Q6(c)

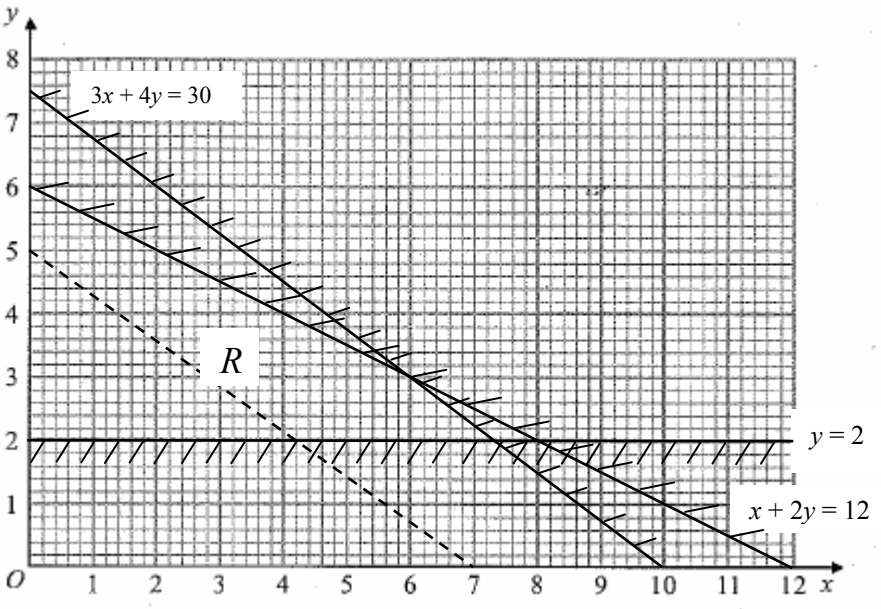


Early times	M1A1	
Late times	M1A1	(4)

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.

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