

GCE Examinations  
Advanced Subsidiary / Advanced Level

**Decision Mathematics**  
**Module D1**

Paper B

**MARKING GUIDE**

This guide is intended to be as helpful as possible to teachers by providing concise solutions and indicating how marks should be awarded. There are obviously alternative methods that would also gain full marks.

Method marks (M) are awarded for knowing and using a method.

Accuracy marks (A) can only be awarded when a correct method has been used.

(B) marks are independent of method marks.



*Written by Shaun Armstrong & Dave Hayes*

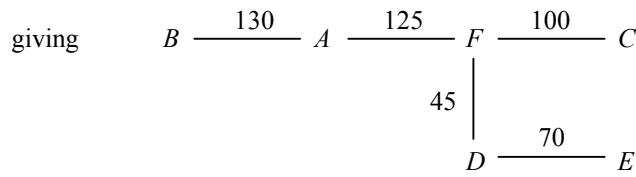
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## D1 Paper B – Marking Guide

1.

<i>order:</i>	5	6	4	1	3	2
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
<i>A</i>	–	130	190	155	140	125
<i>B</i>	130	–	215	200	190	170
<i>C</i>	190	215	–	110	180	100
<i>D</i>	155	200	110	–	70	45
<i>E</i>	140	190	180	70	–	75
<i>F</i>	125	170	100	45	75	–



M2 A2

lowest cost = £470

A1 (5)

2. (a)

<i>n</i>	<i>x<sub>n</sub></i>	<i>a</i>	Any more data?	<i>x<sub>n+1</sub></i>	<i>b</i>	<i>(b – a) &gt; 0?</i>	<i>a</i>
1	8	8	Yes	2	2	No	2
2	–	–	Yes	4	4	Yes	–
3	–	–	Yes	3	3	Yes	–
4	–	–	Yes	5	5	Yes	–
5	–	–	Yes	1	1	No	1
6	–	–	Yes	7	7	Yes	–
7	–	–	No				

Final Output = 1

M2 A4

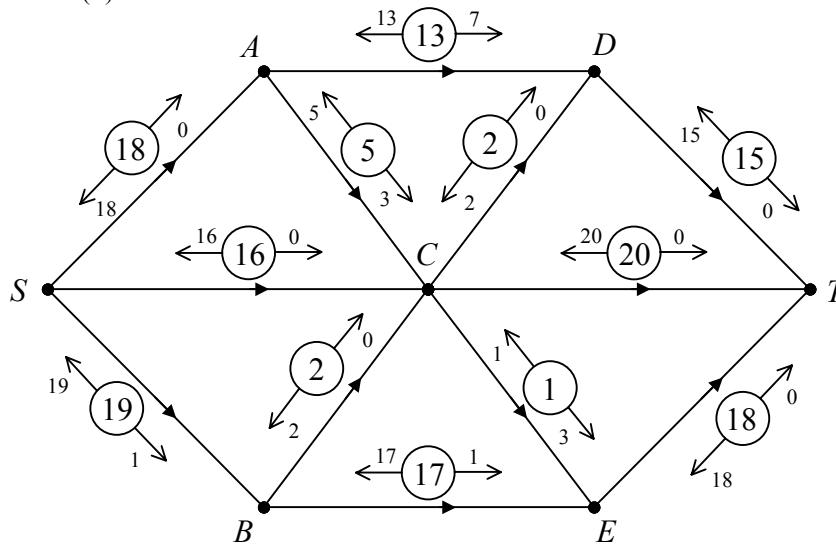
(b) it finds the smallest value in the set of data

B1 (7)

3. (a)  $x = 2, y = 14$

M2 A1

(b) (i) e.g. augment  $SCT$  by 2 and  $SBECADT$  by 3 giving:  
 (ii)



maximum flow = 53

M3 A3

A1

(c) (i) minimum cut = 53, passing through  $DT, CT$  and  $ET$   
 (ii) max flow = min cut  
 it is not possible to get any more flow across this cut

B1

B1 (11)

4. (a) each node is joined to each other node by exactly one arc  
 no node is joined to itself by a loop

B1

(b) (i)  $ABCD A, ABDCA, ACBDA, ACDBA, ADBCA, ADCBA = 6$   
 (3 choices for 2<sup>nd</sup> node, 2 for 3<sup>rd</sup>, 1 for 4<sup>th</sup>  $\therefore 3 \times 2 \times 1$ )

M1 A1

(ii)  $4 \times 3 \times 2 \times 1 = 24$

M1 A1

(iii)  $9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 362880$

M1 A1

(c) 27 25 29 32 19 24 17 26 (pivot in box)

$\underbrace{17}_{L_1}$  19  $\underbrace{27 \ 25 \ 29 \ \underline{32}}_{L_2}$  24 26

17 19  $\underbrace{27 \ 25 \ \underline{29} \ 24 \ 26}_{L_3}$  32

17 19  $\underbrace{27 \ 25 \ \underline{24} \ 26}_{L_4}$  29 32

17 19 24  $\underbrace{27 \ \underline{25} \ 26}_{L_5}$  29 32

17 19 24 25  $\underbrace{27 \ \underline{26}}_{L_6}$  29 32

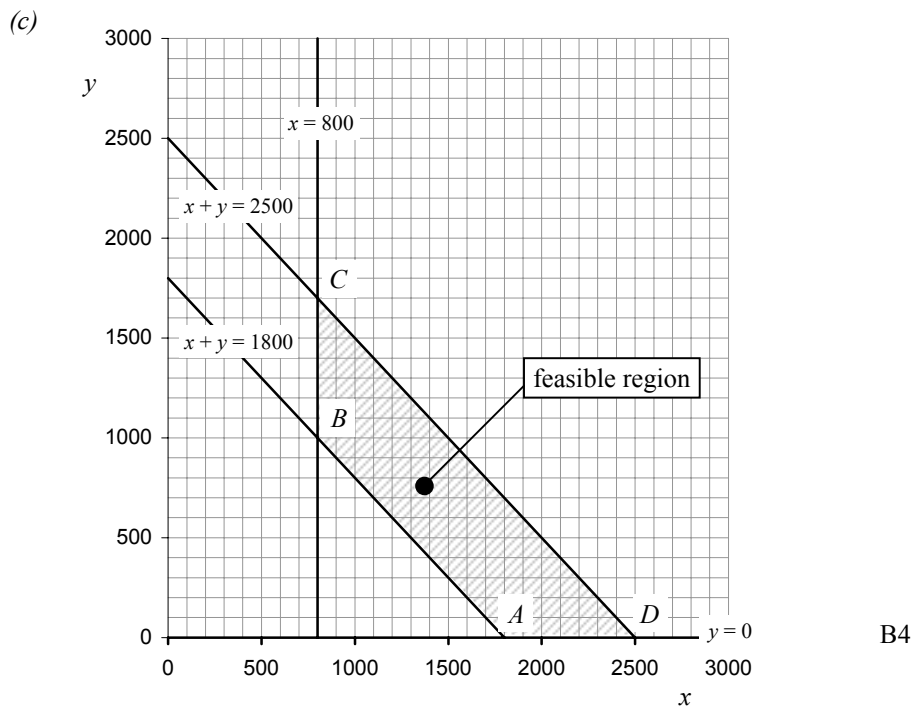
17 19 24 25 26  $\underbrace{27}_{L_7}$  29 32

now complete

M2 A2 (11)

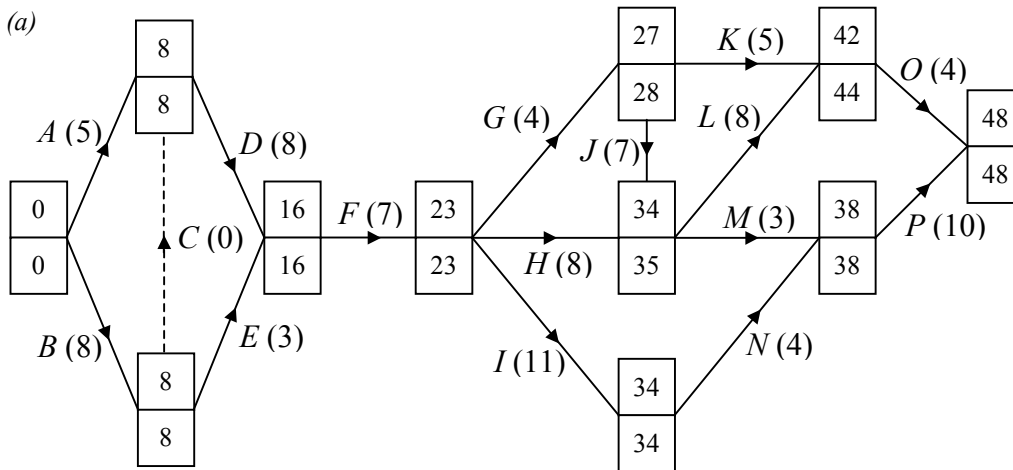
5. (a) odd vertices are  $C$  and  $E$  B1  
shortest  $CE = 28$  M1  
lowest total = sum of all arcs + shortest  $CE$  M1  
=  $218 + 28 = 246$  A1
- (b) odd vertices are  $C, E, P$  and  $Q$  B1  
shortest  $CE$  and  $PQ = 13 + 18 = 31$   
 $CP$  and  $EQ = 33 + 28 = 61$   
 $CQ$  and  $EP = 15 + 20 = 35$ ;  $\therefore$  lowest is 31 M2 A1  
total = sum of all arcs + 31 =  $213 + 31 = 244$  M1 A1
- (c) Logo 2 requires 2 cm less stitching B1 (11)
- 

6. (a) (i)  $x + y + z = 800 + 1000 + 700$   
 $\therefore z = 2500 - x - y$  M1 A1
- (ii) costs =  $500x + 800y + 600z + 100(x - 800) + 150(x + y - 1800)$  M1 A1  
sub in for  $z$  giving: costs =  $150x + 350y + 1\ 150\ 000$  M1 A1
- (b)  $x + y \geq 1800$  and  $x + y \leq 2500$  A2



- (d) considering vertices  $A, B, C$  and  $D$   
minimum cost at  $A$ :  $y = 0$  meets  $x + y = 1800$   
 $\therefore$  should produce 1800 in Sep, 0 in Oct and 700 in Nov M1 A1  
total cost = £1 420 000 A1 (15)
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7. (a)



M3 A3

(b) B, C, D, F, I, N, P

M1 A1

(c) 48 days

A1

(d) F on critical path  $\therefore$  £150 000 penalty  
 if reduce N by more than 1 day it is no longer on critical path  
 $\therefore$  only reduces penalty by £50 000 at cost of £90 000

B3

(e) B, D and P:  
 reducing any of these by 2 days reduces minimum time by 2 days  
 this reduces penalty by £100 000 at cost of £80 000  $\therefore$  profitable

B3 (15)

Total (75)

## Performance Record – D1 Paper B

Question no.	1	2	3	4	5	6	7	Total
Topic(s)	Prim's	flow chart	flows	graphs, Hamiltonian cycles, quick sort	route inspection	linear prog. - graphical	critical path	
Marks	5	7	11	11	11	15	15	75
Student								