

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	



General Certificate of Education
Advanced Level Examination
June 2012

Mathematics

MD02

Unit Decision 2

Thursday 21 June 2012 1.30 pm to 3.00 pm

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed

- 1 hour 30 minutes

- Instructions**
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
 - Fill in the boxes at the top of this page.
 - Answer **all** questions.
 - Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
 - You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
 - Do not write outside the box around each page.
 - Show all necessary working; otherwise marks for method may be lost.
 - Do all rough work in this book. Cross through any work that you do not want to be marked.
 - The **final** answer to questions requiring the use of calculators should be given to three significant figures, unless stated otherwise.

- Information**
- The marks for questions are shown in brackets.
 - The maximum mark for this paper is 75.

- Advice**
- You do not necessarily need to use all the space provided.



J U N 1 2 M D 0 2 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

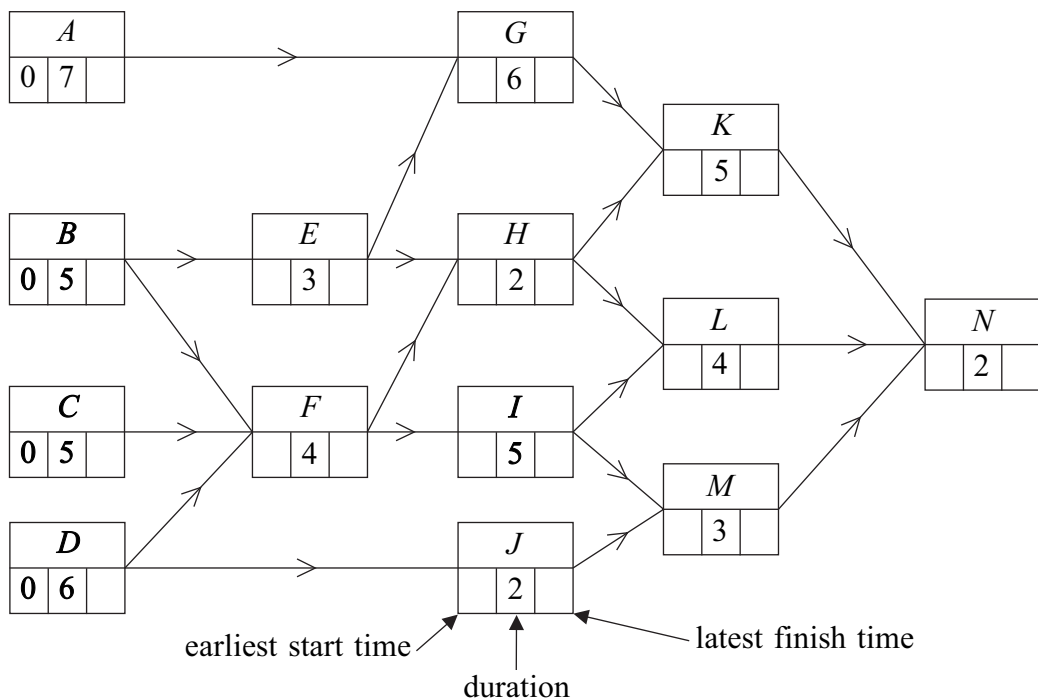
- 1** **Figure 1** below shows an activity diagram for a construction project. The time needed for each activity is given in days.
- (a) Find the earliest start time and the latest finish time for each activity and insert their values on **Figure 1**. (4 marks)
 - (b) Find the critical paths and state the minimum time for completion of the project. (3 marks)
 - (c) On **Figure 2** opposite, draw a cascade diagram (Gantt chart) for the project, assuming that each activity starts as early as possible. (5 marks)
 - (d) Activity *J* takes longer than expected so that its duration is x days, where $x \geq 3$. Given that the minimum time for completion of the project is unchanged, find a further inequality relating to the maximum value of x . (2 marks)

QUESTION PART REFERENCE

Answer space for question 1

(a)

Figure 1



(b)

Critical paths are

.....

Minimum completion time is days.

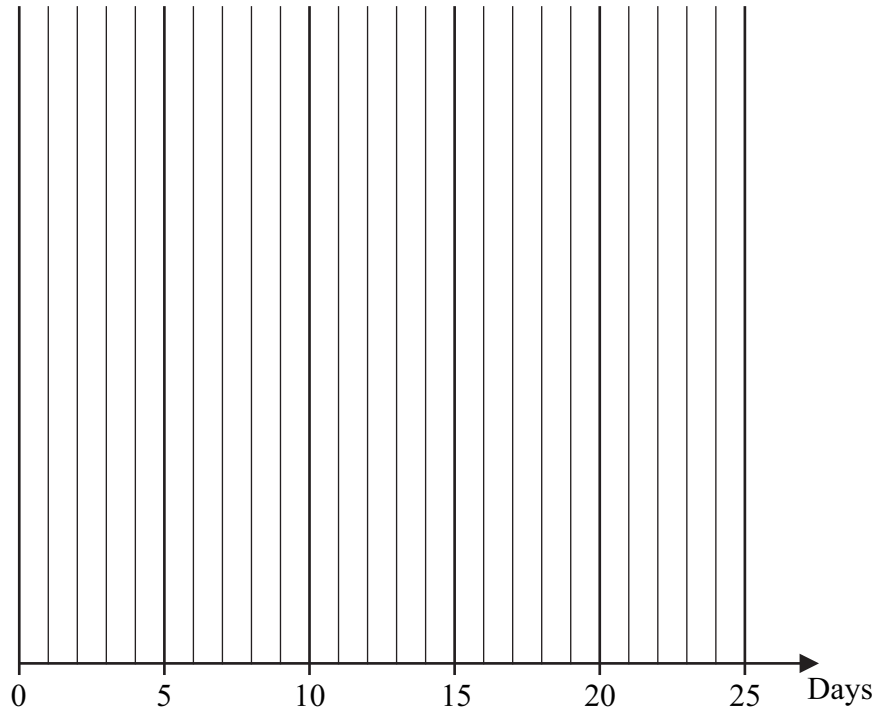


QUESTION
PART
REFERENCE

Answer space for question 1

(c)

Figure 2



(d)

A series of 15 horizontal dotted lines providing space for the answer to part (d).

Turn over ►



QUESTION
PART
REFERENCE

Answer space for question 2

A large rectangular area with horizontal dotted lines for writing an answer.



Turn over ►

3 (a) Given that k is a constant, complete the Simplex tableau below for the following linear programming problem.

Maximise $P = kx + 6y + 5z$

subject to $2x + y + 4z \leq 11$

$x + 3y + 6z \leq 18$

$x \geq 0, y \geq 0, z \geq 0$

(2 marks)

(b) Use the Simplex method to perform **one** iteration of your tableau for part **(a)**, choosing a value in the **y-column** as pivot. (4 marks)

(c) (i) In the case when $k = 1$, explain why the maximum value of P has now been reached and write down this maximum value of P . (2 marks)

(ii) In the case when $k = 3$, perform one further iteration and interpret your new tableau. (6 marks)

QUESTION
PART
REFERENCE

Answer space for question 3

(a)

P	x	y	z	s	t	value
1	$-k$	-6	-5	0	0	0
0						
0						

(b)

P	x	y	z	s	t	value



QUESTION
PART
REFERENCE

Answer space for question 3

(c)(i)

(c)(ii)

<i>P</i>	<i>x</i>	<i>y</i>	<i>z</i>	<i>s</i>	<i>t</i>	<i>value</i>

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QUESTION
PART
REFERENCE

Answer space for question 4(b)

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Turn over ►



QUESTION PART REFERENCE

Answer space for question 5

(b)

Year	Already renovated	House renovated	Calculation	Value
3	<i>A</i> and <i>B</i>	<i>C</i>		
	<i>A</i> and <i>C</i>	<i>B</i>		
	<i>B</i> and <i>C</i>	<i>A</i>		
2	<i>A</i>	<i>B</i>		
		<i>C</i>		
	<i>B</i>	<i>A</i>		
		<i>C</i>		
	<i>C</i>	<i>A</i>		
		<i>B</i>		
1				

Optimum order

.....

.....

.....

.....

.....

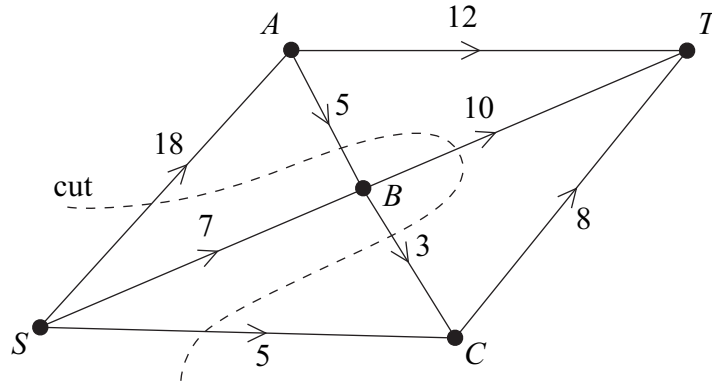
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6 (a) The network shows a flow from S to T along a system of pipes, with the capacity in litres per second indicated on each edge.



(i) Show that the value of the cut shown on the diagram is 36. (1 mark)

.....

.....

(ii) The cut shown on the diagram can be represented as $\{S, B\}, \{A, C, T\}$.

Complete the table below to give the value of each of the 8 possible cuts. (3 marks)

Cut		Value
$\{S\}$	$\{A, B, C, T\}$	30
$\{S, A\}$	$\{B, C, T\}$	29
$\{S, B\}$	$\{A, C, T\}$	36
$\{S, C\}$	$\{A, B, T\}$	33
$\{S, A, B\}$	$\{C, T\}$	
$\{S, A, C\}$	$\{B, T\}$	
$\{S, B, C\}$	$\{A, T\}$	
$\{S, A, B, C\}$	$\{T\}$	30

(iii) State the value of the maximum flow through the network, giving a reason for your answer. (2 marks)

Maximum flow is

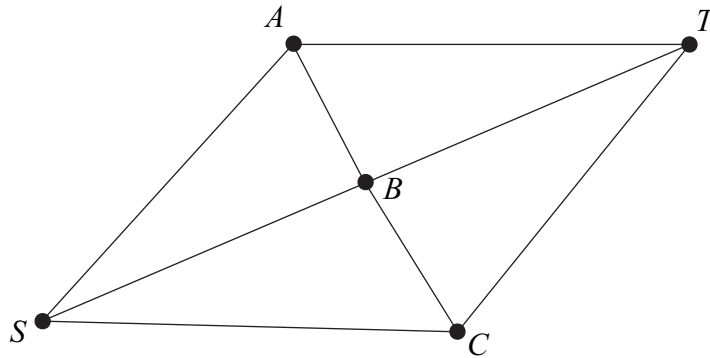
because

.....

.....

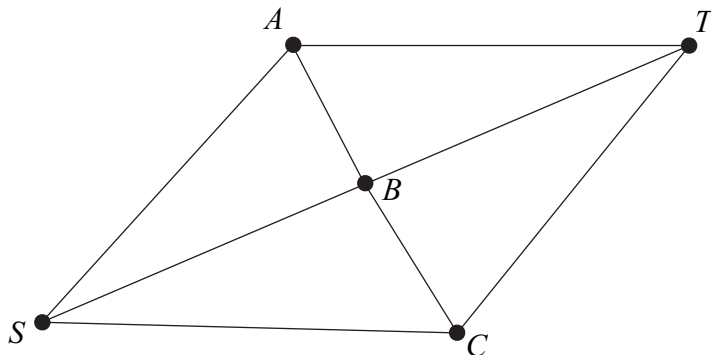


- (iv) Indicate on the diagram below a possible flow along each edge corresponding to this maximum flow. (1 mark)



- (b) The capacities along SC and along AT are each increased by 4 litres per second.

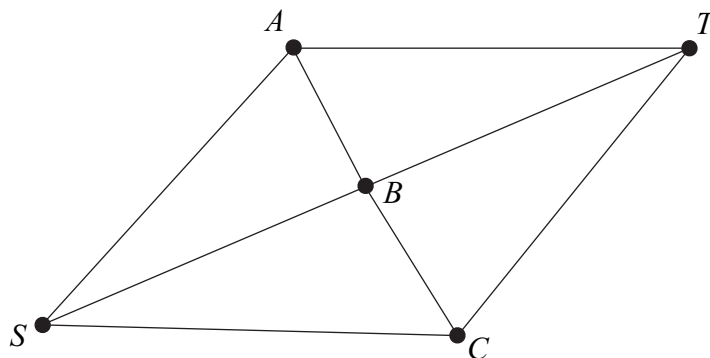
- (i) Using your values from part (a)(iv) as the initial flow, indicate potential increases and decreases on the diagram below and use the labelling procedure to find the new maximum flow through the network. You should indicate any flow augmenting paths in the table and modify the potential increases and decreases of the flow on the diagram. (6 marks)



Path	Additional Flow

- (ii) Use your results from part (b)(i) to illustrate the flow along each edge that gives this new maximum flow, and state the value of the new maximum flow. (3 marks)

New maximum flow is



END OF QUESTIONS



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

