

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	



General Certificate of Education  
Advanced Subsidiary Examination  
June 2014

# Mathematics

# MD01

## Unit Decision 1

Wednesday 18 June 2014 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.

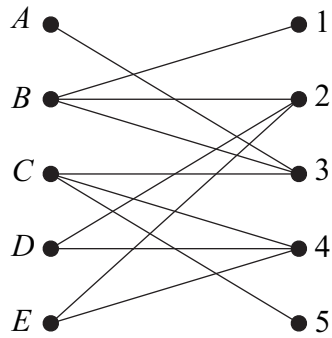


J U N 1 4 M D O 1 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

- 1** Five people, *A*, *B*, *C*, *D* and *E*, are to be allocated to five tasks, 1, 2, 3, 4 and 5. The following bipartite graph shows the tasks that each person is able to undertake.



- (a) Represent this information in an adjacency matrix. **[2 marks]**
- (b) Initially, *A* is allocated to task 3, *B* to task 2 and *C* to task 4.
- (i) Demonstrate, by using an alternating-path algorithm from this initial matching, how each person can be allocated to a different task. **[3 marks]**
- (ii) Find a different allocation of people to tasks. **[1 mark]**

QUESTION  
PART  
REFERENCE

**Answer space for question 1**



QUESTION  
PART  
REFERENCE

**Answer space for question 1**

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

**Turn over ►**



- 2** A document which is currently written in English is to be translated into six other European Union languages. The cost of translating a document varies, as it is harder to find translators for some languages.

The costs, in euros, are shown in the table below.

- (a) (i)** On the **table below**, showing the order in which you select the edges, use Prim's algorithm, starting from  $E$ , to find a minimum spanning tree for the graph connecting  $D, E, F, G, H, I$  and  $S$ .

[5 marks]

- (ii)** Find the length of your minimum spanning tree.

[1 mark]

- (iii)** Draw your minimum spanning tree.

[2 marks]

- (b)** It is given that the graph has a unique minimum spanning tree.

State the final two edges that would be added to complete the minimum spanning tree in the case where:

- (i)** Prim's algorithm starting from  $H$  is used;  
**(ii)** Kruskal's algorithm is used.

[3 marks]

**Answer space for question 2**

	Danish ( $D$ )	English ( $E$ )	French ( $F$ )	German ( $G$ )	Hungarian ( $H$ )	Italian ( $I$ )	Spanish ( $S$ )
Danish ( $D$ )	–	120	140	80	170	140	140
English ( $E$ )	120	–	70	80	130	130	110
French ( $F$ )	140	70	–	90	190	85	90
German ( $G$ )	80	80	90	–	110	100	100
Hungarian ( $H$ )	170	130	190	110	–	140	150
Italian ( $I$ )	140	130	85	100	140	–	60
Spanish ( $S$ )	140	110	90	100	150	60	–



QUESTION  
PART  
REFERENCE

**Answer space for question 2**

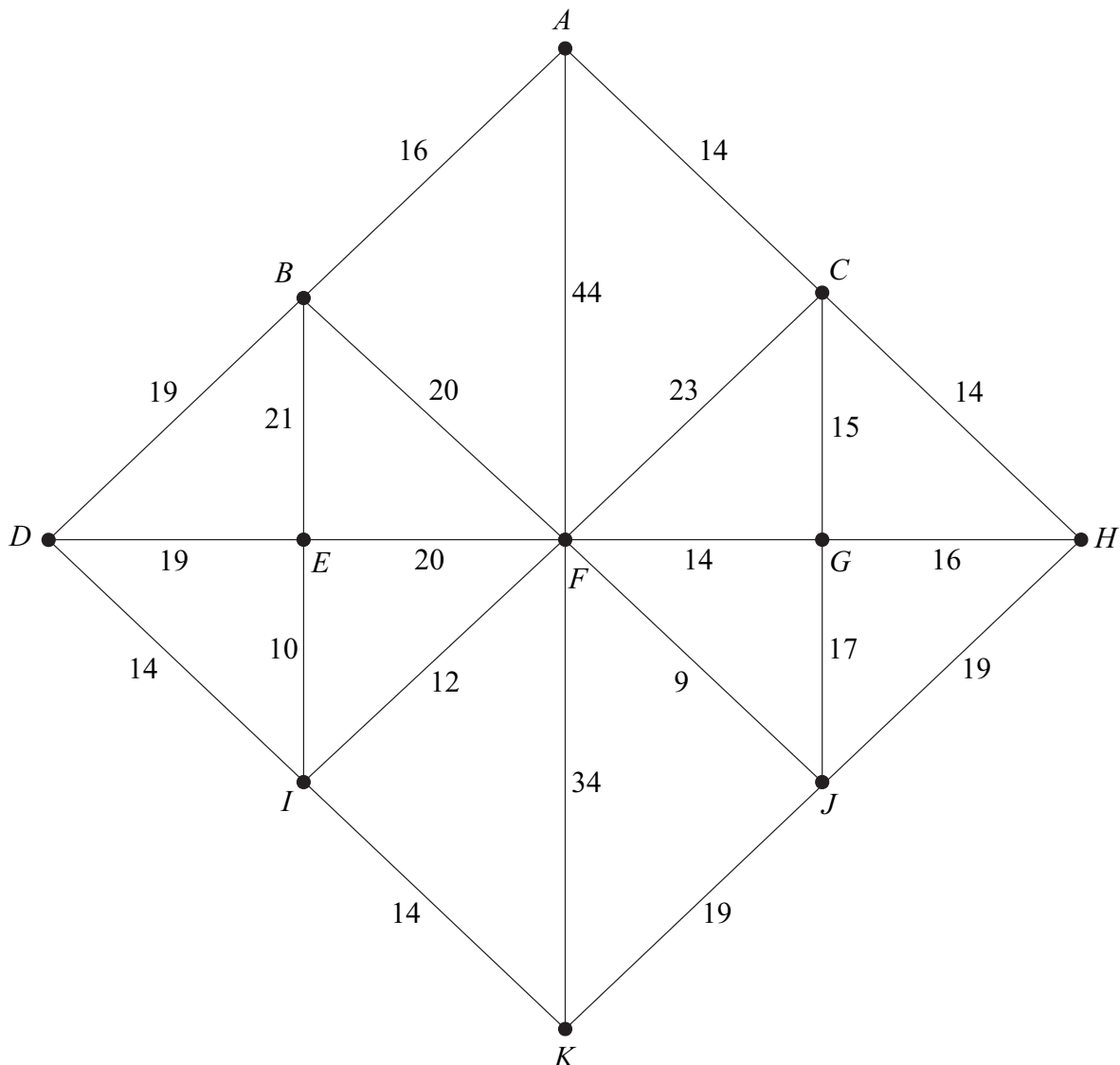
A large rectangular area with horizontal dotted lines for writing an answer.

**Turn over ►**



- 3** The network below shows 11 towns,  $A, B, \dots, K$ . The number on each edge shows the time, in minutes, to travel between a pair of towns.
- (a) (i) Use Dijkstra's algorithm on the diagram below to find the minimum time to travel from  $A$  to  $K$ . **[6 marks]**
- (ii) State the corresponding route. **[1 mark]**
- (b) On a particular day, Jenny travels from  $A$  to  $K$  but visits her friend at  $D$  on her way. Find Jenny's minimum travelling time. **[1 mark]**
- (c) On a different day, all roads connected to  $I$  are closed due to flooding. Jenny does not visit her friend at  $D$ . Find her minimum time to travel from  $A$  to  $K$ . State the route corresponding to this minimum time. **[2 marks]**

**Answer space for question 3**



QUESTION  
PART  
REFERENCE

**Answer space for question 3**

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



**Turn over ►**

QUESTION  
PART  
REFERENCE

**Answer space for question 3**

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





QUESTION  
PART  
REFERENCE

**Answer space for question 3**

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

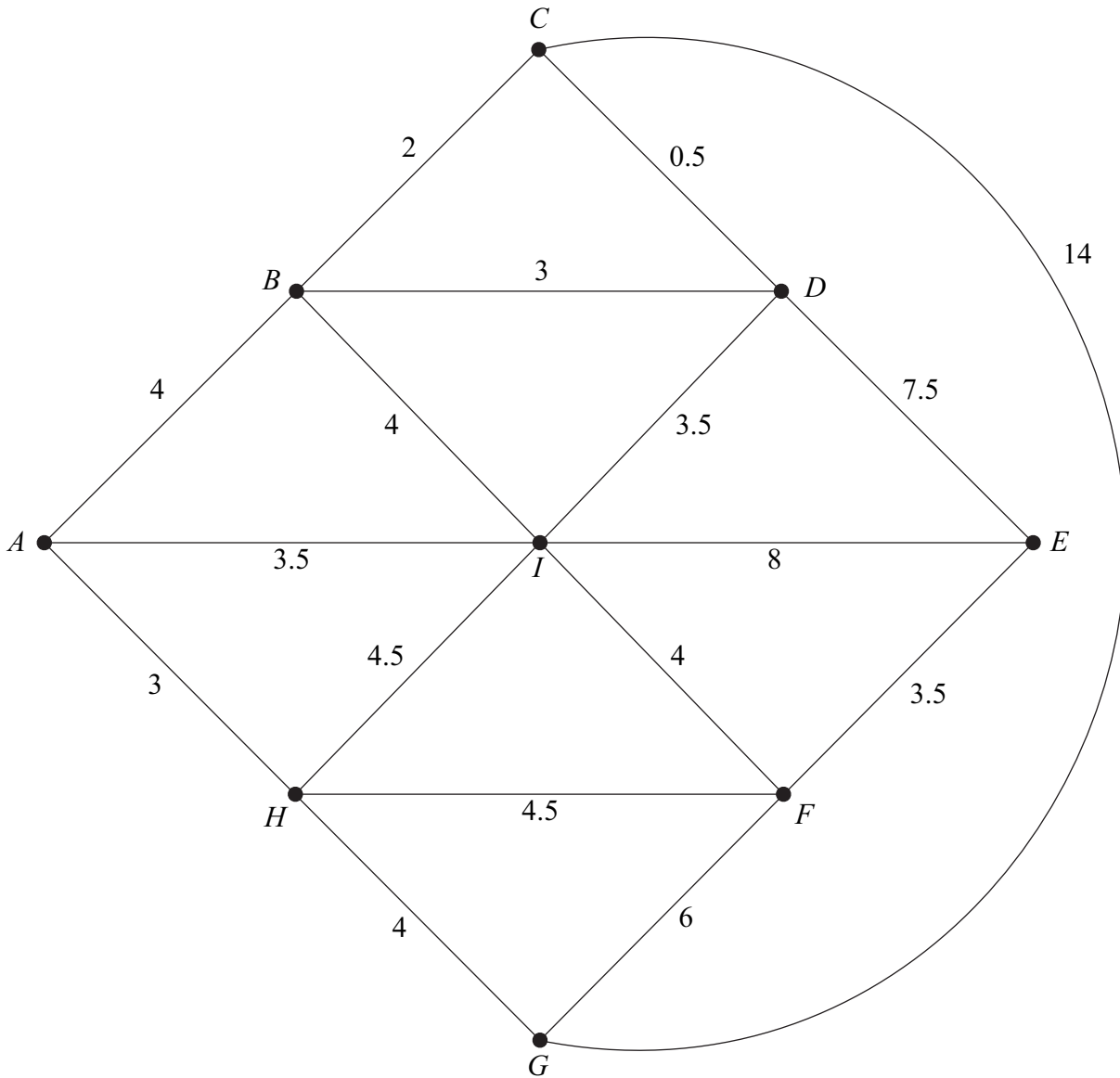
**Turn over ►**



4

Paulo sells vegetables from his van. He drives around the streets of a small village. The network shows the streets in the village. The number on each edge shows the time, in minutes, to drive along that street.

Paulo starts from his house located at vertex  $A$  and drives along all the streets at least once before returning to his house.



The total of all the times in the diagram is 79.5 minutes.





QUESTION  
PART  
REFERENCE

**Answer space for question 4**

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



QUESTION  
PART  
REFERENCE

**Answer space for question 4**

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

**Turn over ►**



5 The feasible region of a linear programming problem is determined by the following:

$$x \geq 1$$

$$y \geq 3$$

$$x + y \geq 5$$

$$x + y \leq 12$$

$$3x + 8y \leq 64$$

(a) On the grid below, draw a suitable diagram to represent the inequalities and indicate the feasible region.

[5 marks]

(b) Use your diagram to find, on the feasible region:

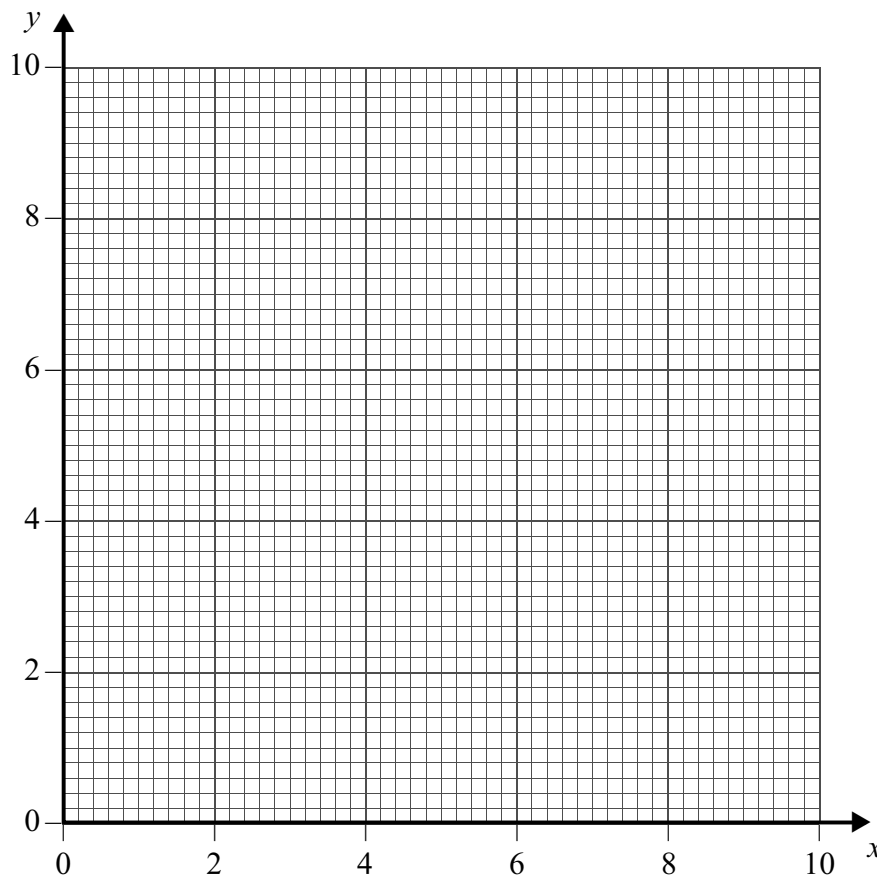
- (i) the maximum value of  $3x + y$ ;
- (ii) the maximum value of  $2x + 3y$ ;
- (iii) the minimum value of  $-2x + y$ .

In each case, state the coordinates of the point corresponding to your answer.

[6 marks]

QUESTION  
PART  
REFERENCE

Answer space for question 5



QUESTION  
PART  
REFERENCE

**Answer space for question 5**

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



**6 (a)** Sarah is solving a travelling-salesman problem.

(i) She finds the following upper bounds: 32, 33, 32, 32, 30, 32, 32.

Write down the best upper bound.

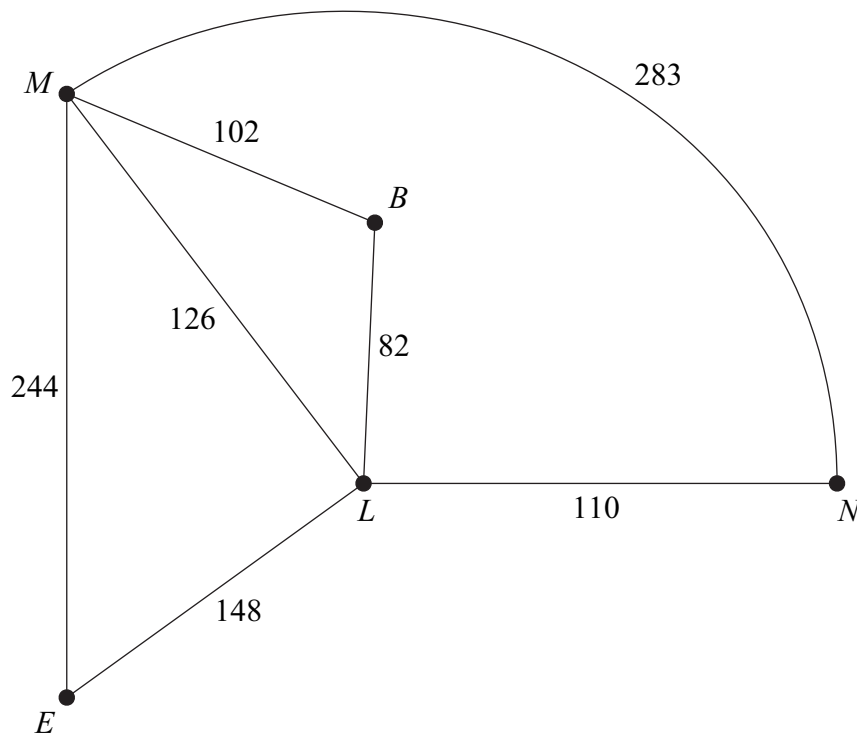
(ii) She finds the following lower bounds: 17, 18, 17, 20, 18, 17, 20.

Write down the best lower bound.

**[2 marks]**

**(b)** Rob is travelling by train to a number of cities. He is to start at  $M$  and visit each other city at least once before returning to  $M$ .

The diagram shows the travelling times, in minutes, between cities. Where no time is shown, there is no direct journey available.



The table below shows the minimum travelling times between all pairs of cities.

	$B$	$E$	$L$	$M$	$N$
$B$	–	230	82	102	192
$E$	230	–	148	244	258
$L$	82	148	–	126	110
$M$	102	244	126	–	236
$N$	192	258	110	236	–







QUESTION  
PART  
REFERENCE

**Answer space for question 6**

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



QUESTION  
PART  
REFERENCE

**Answer space for question 6**

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

**Turn over ►**









QUESTION  
PART  
REFERENCE

**Answer space for question 8**

A large rectangular area with horizontal dotted lines for writing the answer to question 8.

**Turn over ►**



QUESTION  
PART  
REFERENCE

**Answer space for question 8**

Area with horizontal dotted lines for writing the answer to question 8.

**END OF QUESTIONS**

Copyright © 2014 AQA and its licensors. All rights reserved.

