

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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



Free-Standing Mathematics Qualification
Advanced Level
June 2014

Using and Applying Decision Mathematics

6994/2

Unit 14

Tuesday 13 May 2014 1.30 pm to 3.00 pm

- For this paper you must have:**
- a clean copy of the Data Sheet (enclosed)
 - a calculator
 - a ruler.

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.
- You may **not** refer to the copy of the Data Sheet that was available prior to this examination. A clean copy is enclosed for your use.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You may use either a scientific calculator or a graphics calculator.

Advice

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



J U N 1 4 6 9 9 4 / 2 0 1

Section AAnswer **all** questions.

Answer each question in the space provided for that question.

*Use **Cooking outdoors** on page 2 of the Data Sheet.*

- 1** A meal is being prepared. The work involved has been divided into a number of tasks, as shown in the table.

Activity	Immediate predecessor	Duration (minutes)
<i>A</i> : Boil water	–	5
<i>B</i> : Prepare food	–	75
<i>C</i> : Collect wood from wood store	–	20
<i>D</i> : Set table	–	10
<i>E</i> : Light wood and wait	<i>C</i>	25
<i>F</i> : Cook pasta sauce	<i>B</i>	20
<i>G</i> : Cook vegetables	<i>B, E</i>	35
<i>H</i> : Grill sausages on BBQ	<i>B, E</i>	20
<i>I</i> : Put chickens on the rotisserie and cook	<i>B, E</i>	60
<i>J</i> : Put pasta into boiling water and cook	<i>A</i>	12
<i>K</i> : Mix pasta with sauce	<i>F, J</i>	5
<i>L</i> : Serve	<i>D, G, H, I, K</i>	5

- (a) On page 3, construct an activity network for the work involved. **[4 marks]**
- (b) Find the earliest start time for each activity. **[2 marks]**
- (c) Find the latest finish time for each activity. **[3 marks]**
- (d) Find the critical activities. **[1 mark]**
- (e) Using the grid on page 5, draw a cascade (Gantt) diagram for the work involved. **[4 marks]**
- (f) The pasta must not be cooked until the latest possible time. The plan is to serve the meal by 3 pm. Find the latest time that the pasta should be put into the boiling water. **[2 marks]**
- (g) In fact, the chickens take an extra 10 minutes to cook. At what time can everyone start eating? **[1 mark]**



QUESTION
PART
REFERENCE

Answer space for question 1

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QUESTION
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REFERENCE

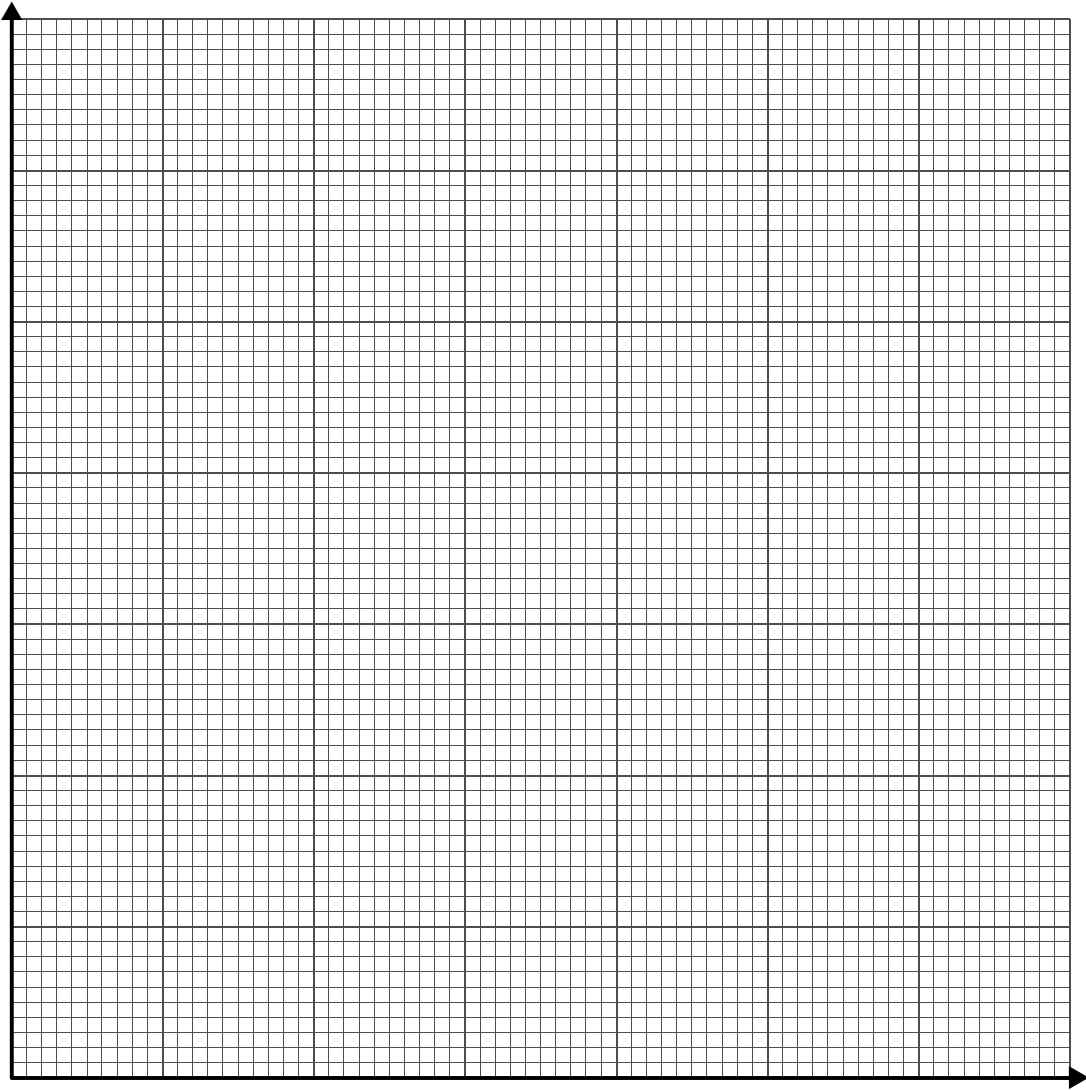
Answer space for question 1

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QUESTION
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Answer space for question 1



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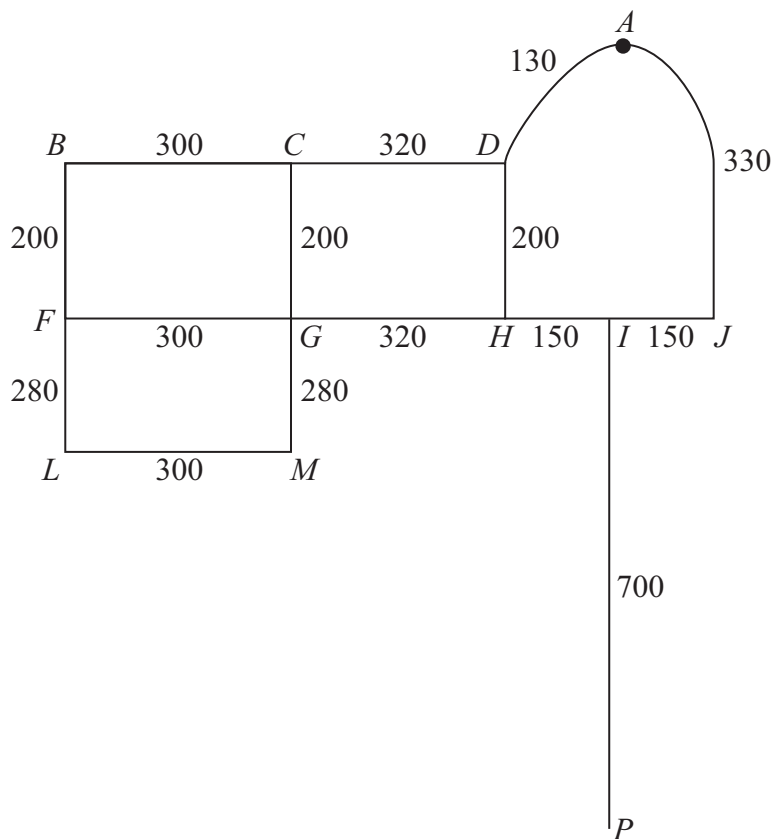


Section BAnswer **all** questions.

Answer each question in the space provided for that question.

Use **Temple of Heaven, Beijing** on pages 4 and 5 of the Data Sheet.

- 2** The diagram shows a network of paths connecting 12 places. The number on each edge is the length, in metres, of the path between a pair of places. All of the places are to have speakers installed. The speakers are to be connected by cabling laid alongside the paths.



- (a) Showing the order in which you select the edges, use Kruskal's algorithm to find a minimum spanning tree for the 12 places. [5 marks]
- (b) State the length of your minimum spanning tree. [1 mark]
- (c) Draw your minimum spanning tree. [2 marks]



QUESTION
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QUESTION
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QUESTION
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Answer space for question 2

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QUESTION
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Answer space for question 3

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QUESTION
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Answer space for question 3

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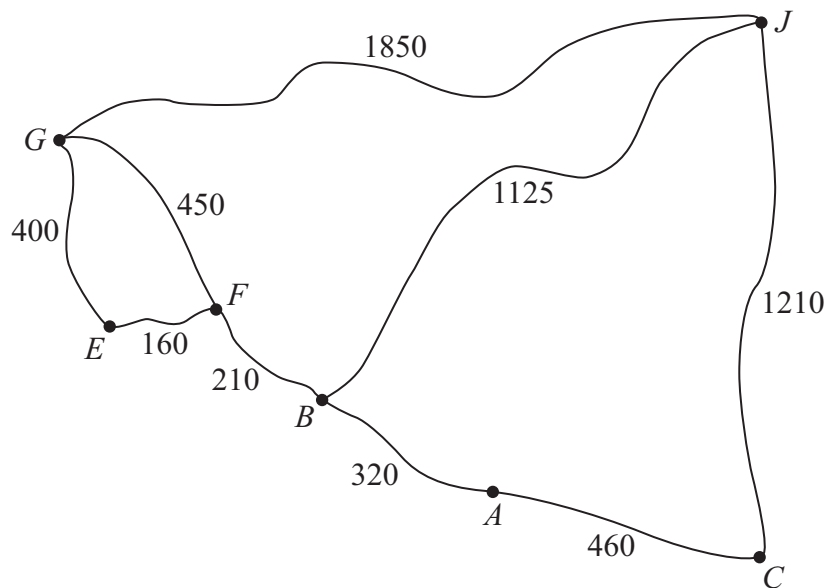
Section C

Answer **all** questions.

Answer each question in the space provided for that question.

Use **Valley of the Temples, Agrigento** on page 6 of the Data Sheet.

- 4** The diagram shows the locations of some of the historic places. The number on each edge shows the distance, in metres, between a pair of places.



Rita, a tourist, intends to travel from one place until she has visited all the places before returning to her starting place.

The shortest distances for Rita to travel between some of the places are shown in **Table 1** opposite.

- (a) Complete **Table 1**.

[2 marks]

- (b) (i) On the completed **Table 1**, use the nearest neighbour algorithm, starting from *B*, to find an upper bound for the length of Rita's minimum tour.

[4 marks]

- (ii) Write down Rita's actual route if she were to follow the tour corresponding to the answer in part (b)(i).

[2 marks]

Question 4 continues on page 16



(c) (i) On **Table 2** below, showing the order in which you select the edges, use Prim's algorithm, starting from *A*, to find a minimum spanning tree for the places *A*, *B*, *C*, *E*, *F* and *G*.

[4 marks]

(ii) Hence find a lower bound for the length of Rita's minimum tour.

[2 marks]

(d) Given that the length of a minimum tour is *T* metres, use your answers to parts (b) and (c) to write down a conclusion about the length of Rita's minimum tour.

[2 marks]

QUESTION
PART
REFERENCE

Answer space for question 4

Table 2

	<i>A</i>	<i>B</i>	<i>C</i>	<i>E</i>	<i>F</i>	<i>G</i>
<i>A</i>	–	320	460	690	530	980
<i>B</i>	320	–	780	370	210	660
<i>C</i>	460	780	–	1150	990	1440
<i>E</i>	690	370	1150	–	160	400
<i>F</i>	530	210	990	160	–	450
<i>G</i>	980	660	1440	400	450	–



QUESTION
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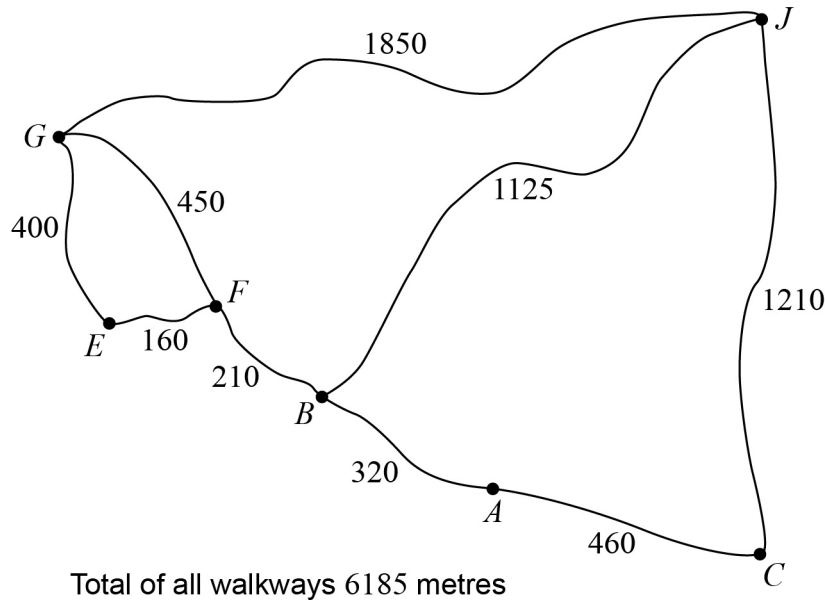
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5 The diagram shows the locations of some of the historic places. The number on each edge shows the distance, in metres, between a pair of places. Each edge represents a walkway.

Every evening, Salvatore has to empty the rubbish bins in the Valley of the Temples. He has to walk at least once along all of the walkways shown in the diagram.



- (a) Find the length of an optimal Chinese postman route around the walkways, starting and finishing at *E*. [5 marks]
- (b) In an optimal route corresponding to your answer to part (a), state the number of times:
 - (i) the place *C* would appear; [1 mark]
 - (ii) the place *G* would appear. [1 mark]
- (c) (i) If Salvatore can start and finish at different places, find the length of an optimal route. [1 mark]
- (ii) State the places where Salvatore must start and finish in order to achieve the answer found in part (c)(i). [1 mark]

QUESTION
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Answer space for question 5



QUESTION
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Answer space for question 5

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QUESTION
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END OF QUESTIONS

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