Free-Standing Mathematics Qualification
June 2008
Advanced Level

USING & APPLYING DECISION MATHEMATICS 6994/2
Unit 14

Monday 12 May 2008 9.00 am to 10.30 am

For this paper you must have:
- an 8-page answer book
- a clean copy of the Data Sheet (enclosed)
- a calculator
- a ruler
- an answer sheet for use in Questions 2, 3 and 4 (enclosed).

Time allowed: 1 hour 30 minutes

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is 6994/2.
- Answer **all** questions.
- Show all necessary working; otherwise marks for method may be lost.
- 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 available for your use.
- Fill in the boxes at the top of the answer sheet. Make sure you attach the answer sheet to your answer book.

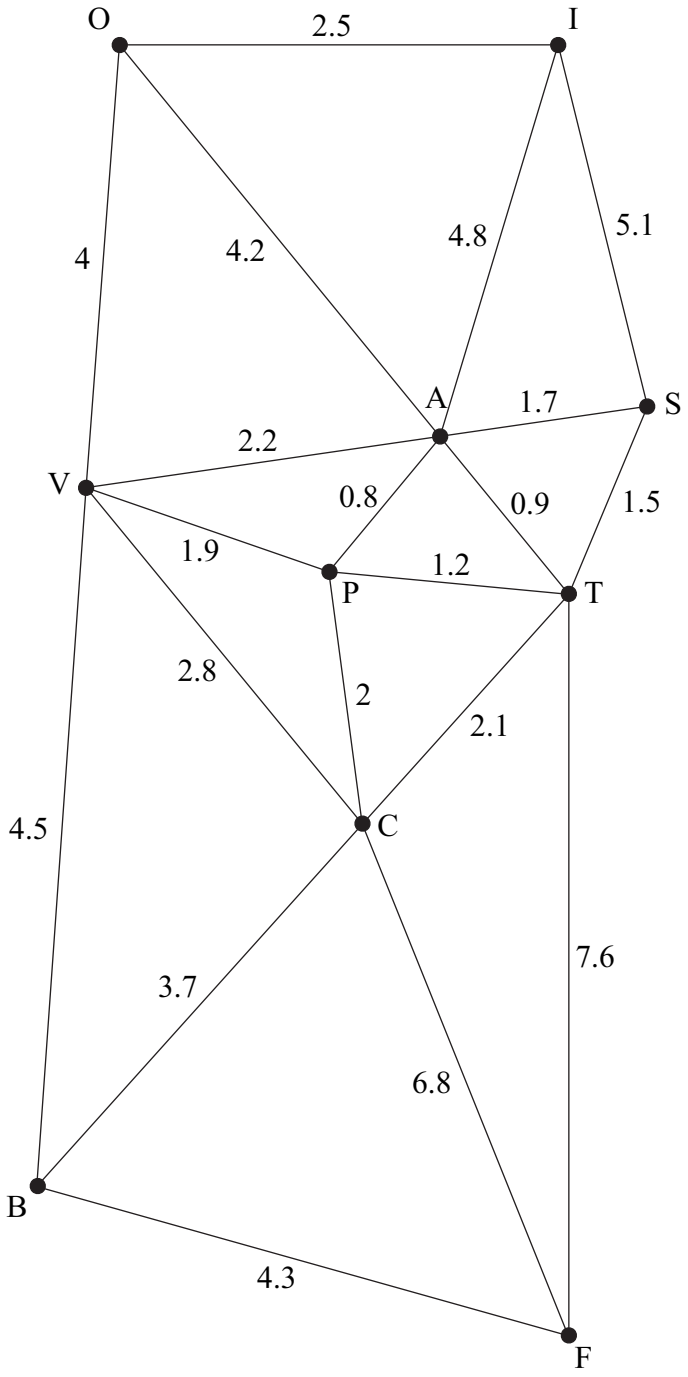
Information
- The maximum mark for this paper is 60.
- The marks for questions are shown in brackets.
- You may use either a scientific or a graphics calculator.

SECTION A

Answer **all** questions in the spaces provided.

Use **Rome** *on pages 2 and 3 of the Data Sheet.*

1 The diagram below shows roads connecting ten of the main attractions in Rome. The numbers on the edges represent the lengths of the roads, in kilometres.



The city council is to connect these ten attractions with a computer system, which will display waiting times at each attraction. This is to help tourists decide in which order they should visit these attractions.

The cabling for the computer system is to be laid alongside some of the existing roads.

(a) (i) Use Kruskal's algorithm to find a minimum spanning tree for the ten attractions. Indicate the order in which you select the edges. *(5 marks)*

(ii) State the minimum length of cabling needed. *(1 mark)*

(iii) Draw your minimum spanning tree. *(2 marks)*

(b) Give a reason why your solution to part (a) may not be the solution chosen by the city council. *(1 mark)*

(c) (i) There is already a cable connecting CF.

In addition to this cable find the minimum amount of cabling required to connect the ten attractions. *(2 marks)*

(ii) The council finds that it cannot lay a cable connecting AT directly.

Find the extra amount of cabling that is now required to complete the minimum spanning tree. *(2 marks)*

Turn over for the next question

SECTION B

Answer **all** questions.

Use **ICT system** *on page 4 of the Data Sheet.*

2 [**Grid 1, printed on the answer sheet, is provided for use in Question 2(e).**]

The consultancy company has divided the work into a number of activities, as shown in the table below.

Activity	**Immediate predecessor**	**Planned duration (weeks)**
A: Decide on new system	–	1
B: Prepare ICT control room	A	2
C: Buy hardware (including delivery)	A	5
D: Buy software (including delivery)	A	2
E: Train ICT staff	B, C, D	2
F: Install cabling	C	2
G: Install hardware	E, F	1
H: Install software	G	1
I: Prepare pupil/staff data	A	5
J: Install data	H, I	1
K: Train teaching staff	H	2
L: Test system	J, K	1

(a) Construct an activity network for the project. *(4 marks)*

(b) Find the earliest start time for each activity. *(2 marks)*

(c) Find the latest finish time for each activity. *(2 marks)*

(d) List the critical activities. *(2 marks)*

(e) On the grid given on the answer sheet, construct a Gantt (cascade) diagram for the project. *(4 marks)*

SECTION C

Answer **all** questions.

Use **Mileage chart** *on page 5 of the Data Sheet.*

3 [**Table 1, printed on the answer sheet, is provided for use in Question 3(a).**]

Tony, a politician, is to tour five cities: Birmingham (B), Liverpool (L), Manchester (M), Nottingham (N) and Sheffield (S), on general election day. He intends to travel from one city to the next until he has visited all the cities before returning to his starting city.

The distances, in miles, between the cities are shown on the data sheet.

(a) Complete the table given on the answer sheet. *(2 marks)*

(b) (i) Find the length of the tour using the nearest neighbour algorithm starting from M. *(4 marks)*

(ii) Find the length of the tour using the nearest neighbour algorithm starting from S. *(3 marks)*

(c) (i) By deleting M, find a lower bound for the length of a minimum tour. *(4 marks)*

(ii) By deleting S, find another lower bound for the length of a minimum tour. *(3 marks)*

(d) The length of a minimum tour is T miles. Use your answers to parts (b) and (c) to write down the smallest interval within which T must lie. *(2 marks)*

Turn over for the next question

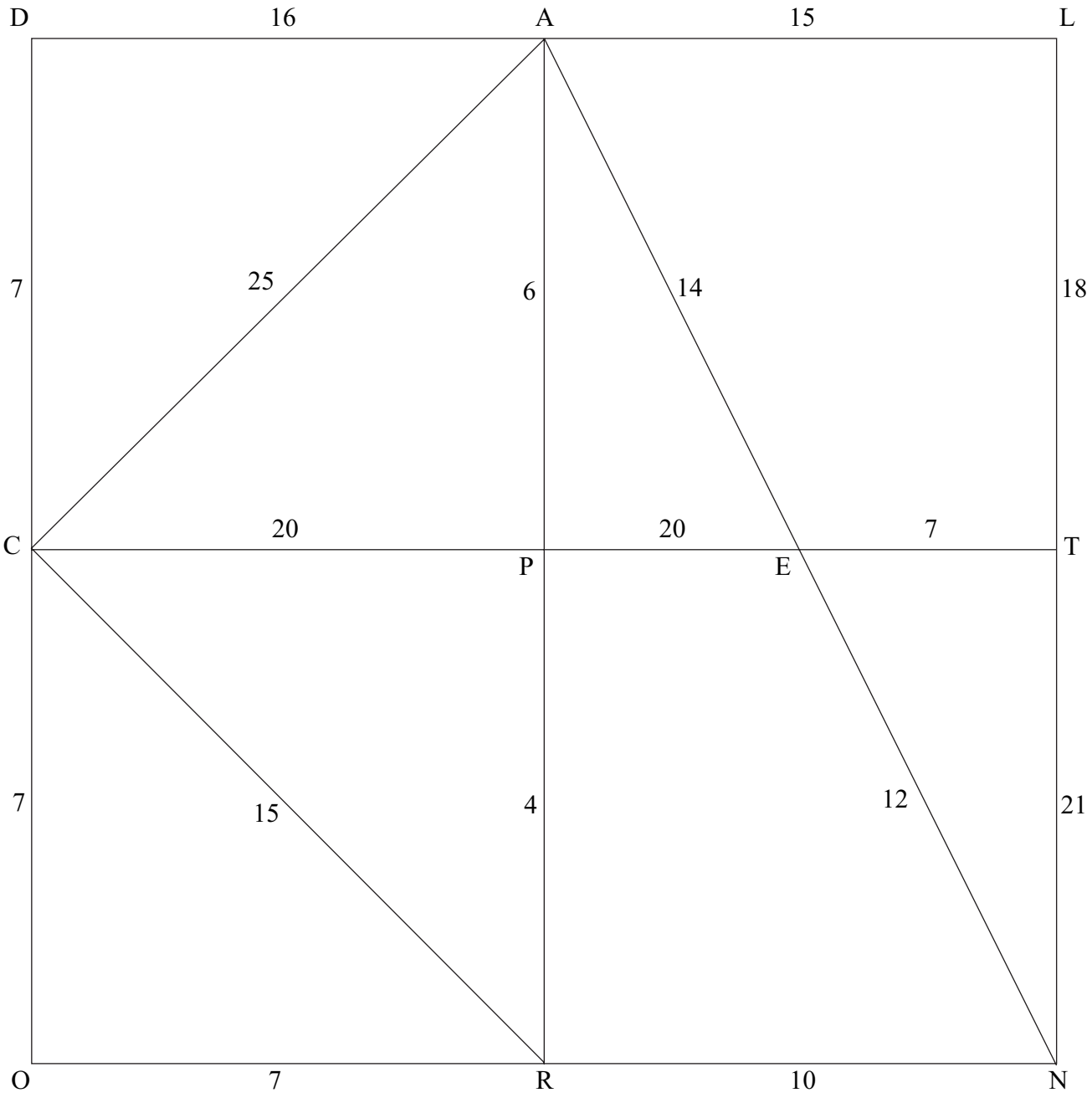
SECTION D

Answer **all** questions.

Use **Road network** *on page 6 of the Data Sheet.*

4 [**Figure 1, printed on the answer sheet, is provided for use in Question 4(a).**]

The diagram shows a network of roads connecting ten places in a town. The number on each edge represents the travelling time in minutes.



(a) Use Dijkstra's algorithm on Figure 1 on the answer sheet to find the shortest travelling time from C to T. Show all temporary labels. State the corresponding route. *(6 marks)*

(b) Raimondo, an ice-cream salesman, travels along all of the roads at least once.

(i) Find the length of an optimal 'Chinese postman' route around the town. *(6 marks)*

(ii) Find the length of an optimal route around the town, given that he can start and finish at different places. State the places where he must start/finish to achieve this minimum. *(3 marks)*

END OF QUESTIONS

There are no questions printed on this page

Surname		Other Names	
Centre Number						Candidate Number				
Candidate Signature										

Free-Standing Mathematics Qualification
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ASSESSMENT and QUALIFICATIONS ALLIANCE

USING & APPLYING DECISION MATHEMATICS 6994/2AS
Unit 14

Answer sheet for use in Questions 2, 3 and 4.

Fasten this answer sheet securely to your answer book.

Grid 1, for use in answering Question 2(e)

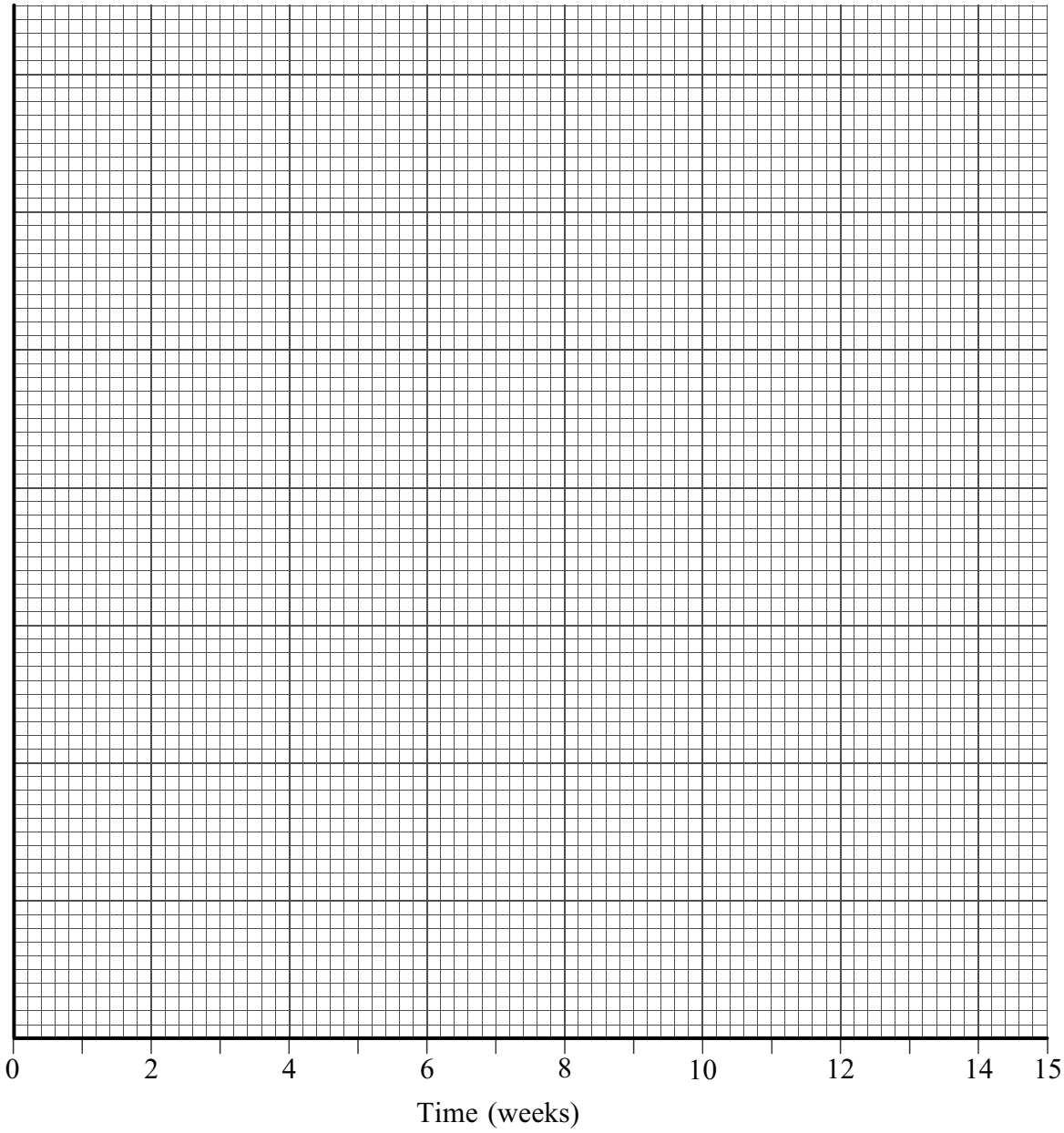
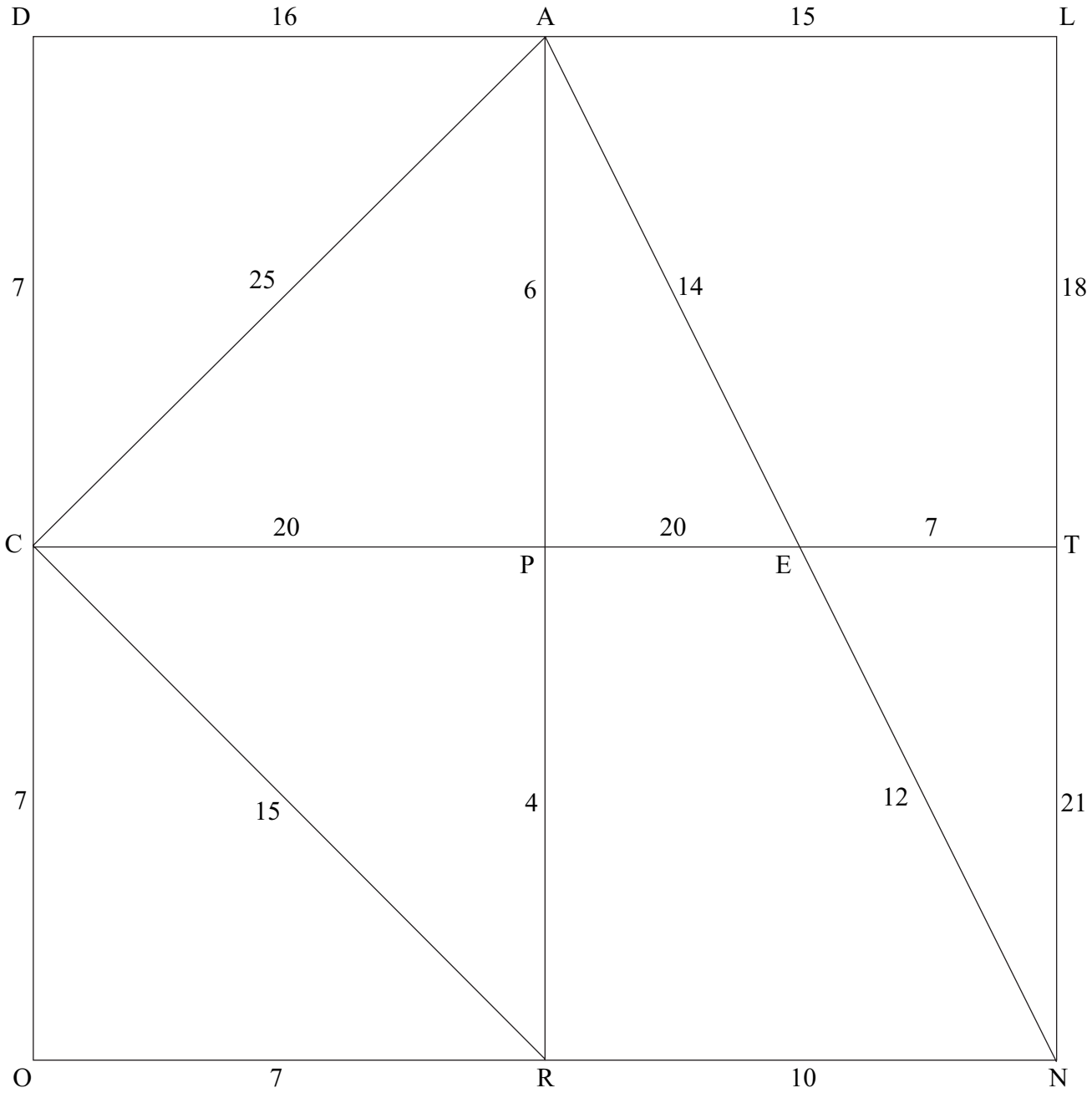


Table 1, for use in answering Question 3(a)

	Birmingham B	Liverpool L	Manchester M	Nottingham N	Sheffield S
Birmingham B	–	102		54	76
Liverpool L	102	–			79
Manchester M			–	71	
Nottingham N	54		71	–	44
Sheffield S	76	79		44	–

Figure 1, for use in answering Question 4(a)



END OF ANSWER SHEET