

Free-Standing Mathematics Qualification
June 2007
Advanced Level



USING & APPLYING DECISION MATHEMATICS **6994/2**
Unit 14

Tuesday 15 May 2007 1.30 pm to 3.00 pm

For this paper you must have:

- an 8-page answer book
- an answer sheet for use in Question 3 (enclosed)
- a calculator
- a clean copy of the Data Sheet (enclosed).

Time allowed: 1 hour 30 minutes

Instructions

- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Write the information required on the front of your answer book **and** on the top of the answer sheet for Question 3. The *Examining Body* for this paper is AQA. The *Paper Reference* is 6994/2.
- Answer **all** questions.
- All necessary working should be shown; otherwise marks for method may be lost.
- The **final** answer to questions requiring the use of a calculator should normally be given to three significant figures.
- 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.
- At the end of the examination, remember to hand in both your answer book **and** the answer sheet for Question 3.

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.

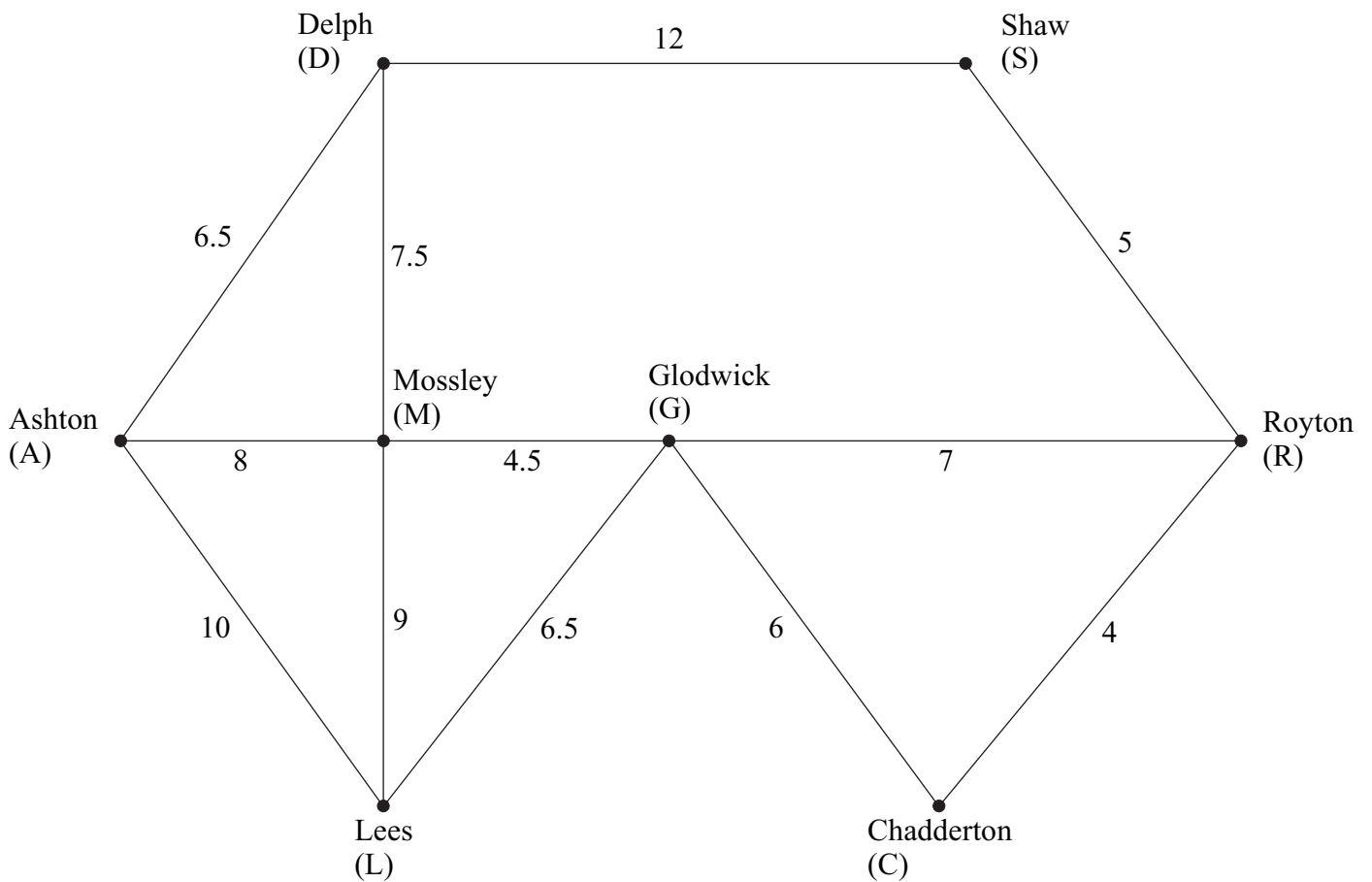
SECTION A

Answer **all** questions.

Use **Road network** on page 2 of the Data Sheet.

- 1 The diagram shows a network of roads connecting 8 places near Oldham.

The number on each edge is the length, in miles, of the road.



- (a) A police patrol car based at Royton has to travel along each road at least once before returning to Royton.

Find the length of an optimal ‘Chinese postman’ route for the police patrol car.

(7 marks)

- (b) After a storm, a council worker needs to inspect all the roads for flood damage. The worker starts his inspection from Royton, where he lives. He finishes his inspection at his office in Lees.

Find the length of an optimal route for the council worker.

(3 marks)

SECTION B

Answer **all** questions.

*Use **Building project** on page 2 of the Data Sheet.*

- 2 A garage is to be converted into a granny flat. The external work on the building has been completed and the inside is to be fitted out. This work has been divided into a number of activities, as shown in the table.

Activity	Immediate predecessor	Planned duration (days)
A: Studding	–	2
B: Initial electrics	A	1
C: Initial plumbing	A	1.5
D: Insulating walls	B, C	2
E: Plastering	D	2.5
F: Artexing ceilings	E	1
G: All joinery	E	3
H: Final electrics	E	1
I: Final plumbing	E	1.5
J: Decorating	F, G	1
K: Cleaning	H, I, J	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) Write down the critical activities. *(2 marks)*
- (e) (i) Write down the float time of activity B. *(1 mark)*
- (ii) State the activity with the greatest float time. *(1 mark)*
- (f) Both plumbing activities take twice as long as planned.
- Find the new completion time for the whole project. *(3 marks)*

Turn over ►

SECTION C

Answer **all** questions.

Use Sicily on page 3 of the Data Sheet.

3 [Figure 1 on the answer sheet is provided for use in answering this question.]

Dino, who lives at St. Vincenzo (SV), intends to travel to the beach at Siculiana (S).

(a) Use Dijkstra's algorithm on **Figure 1** to find the minimum distance from St. Vincenzo to Siculiana. Show all temporary labels. State the corresponding route. *(6 marks)*

(b) Dino drives at 50 km per hour on country roads and 100 km per hour on main roads.

Find the minimum driving time, in hours, from St. Vincenzo to Siculiana. State the corresponding route. *(7 marks)*

4 There is a shortage of water in Sicily. The local council intends to build a desalination plant at Port Empedocle (PE) and wishes to lay a new water-pipe system alongside some of the existing roads.

(a) Use Prim's algorithm, starting from Port Empedocle, to find a minimum spanning tree for the network of the 12 places. *(4 marks)*

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

(c) State the minimum length of piping needed. *(1 mark)*

(d) Give **two** reasons why your solution to part (a) may not be the solution adopted by the local council. *(2 marks)*

Turn over for the next question

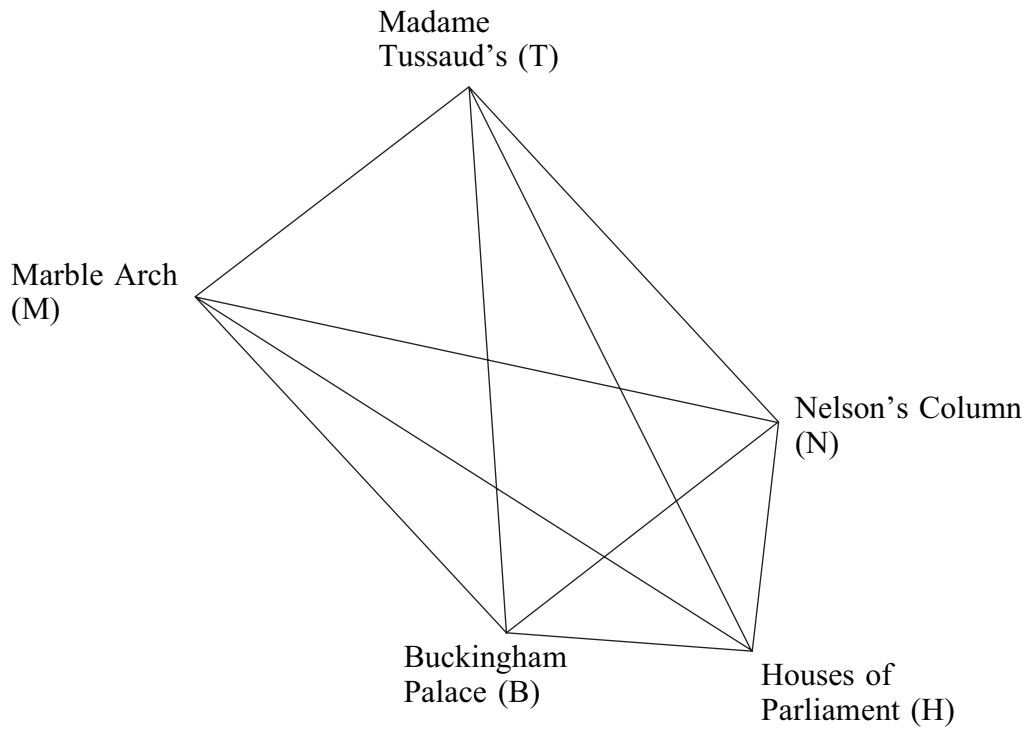
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SECTION D

Answer **all** questions.

Use **London tourist attractions** on page 4 of the Data Sheet.

- 5 A part of London is represented by the following diagram.



A tourist, Jess, wishes to visit five places: Nelson's Column (N), Houses of Parliament (H), Marble Arch (M), Madame Tussaud's (T) and Buckingham Palace (B).

The table shows the times, in minutes, to travel between these places.

Jess wishes to keep her travelling time to a minimum.

	N	H	M	T	B
N	–	5	45	54	15
H	5	–	48	49	10
M	45	48	–	15	53
T	54	49	15	–	40
B	15	10	53	40	–

- (a) (i) Find the travelling time for the tour HNMTBH. *(2 marks)*
- (ii) Find the travelling time for Jess's tour using the nearest neighbour algorithm starting from H. *(4 marks)*
- (b) By deleting T, find a lower bound for the travelling time for the minimum tour. *(5 marks)*
- (c) Sketch a network showing the edges that give the lower bound found in part (b) and comment on its significance. *(2 marks)*

END OF QUESTIONS

There are no questions printed on this page

Surname					Other Names				
Centre Number					Candidate Number				
Candidate Signature									

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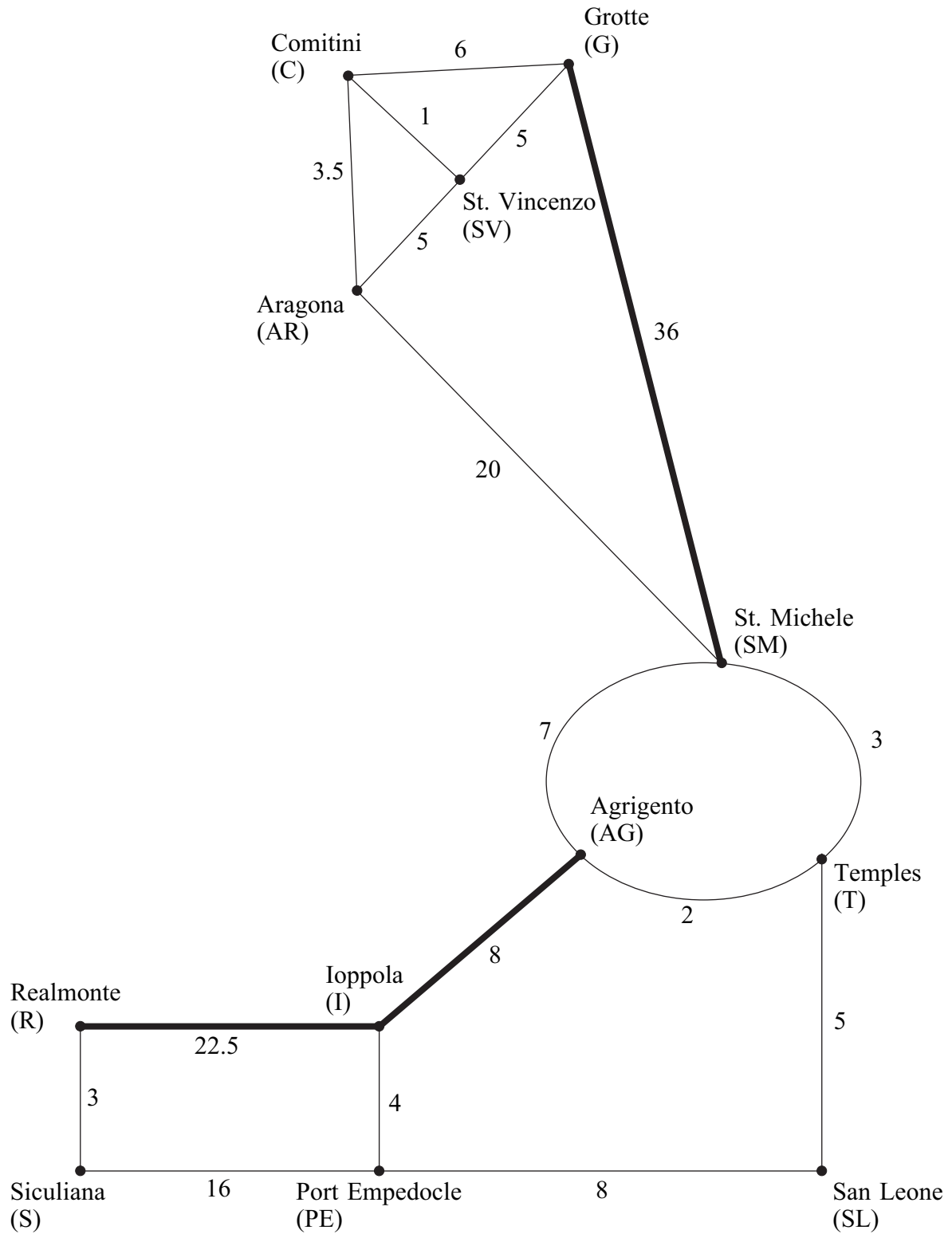
This answer sheet is to be used when answering Question 3, as indicated.

Fasten this sheet securely to your answer book.

Turn over

This diagram is to be used when answering Question 3.

Figure 1



END OF ANSWER SHEET