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 2010

Using and Applying Decision Mathematics

6994/2

Unit 14

Tuesday 18 May 2010 9.00 am to 10.30 am

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 or coloured 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 the questions in the spaces provided. 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.

Section A

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

Use **Chest of drawers** *on page 2 of the Data Sheet.*

1 A chest of drawers is being constructed from a kit. The work involved has been divided into a number of tasks, as shown in the table. The minimum time required to complete each task is also shown.

Activity	**Immediate predecessor**	**Duration (minutes)**
A: Assemble back	–	15
B: Assemble sides	–	35
C: Glue drawers	–	30
D: Fit drawers	A, B, C	25
E: Fit drawer handles	D	10
F: Fit top	A, B	15
G: Clear away packaging	A, B, C	5
H: Varnish	D, F	50
I: Polish	E, G, H	30

(a) **In the space opposite**, 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. *(3 marks)*

(d) State the non-critical activities and their float times. *(3 marks)*

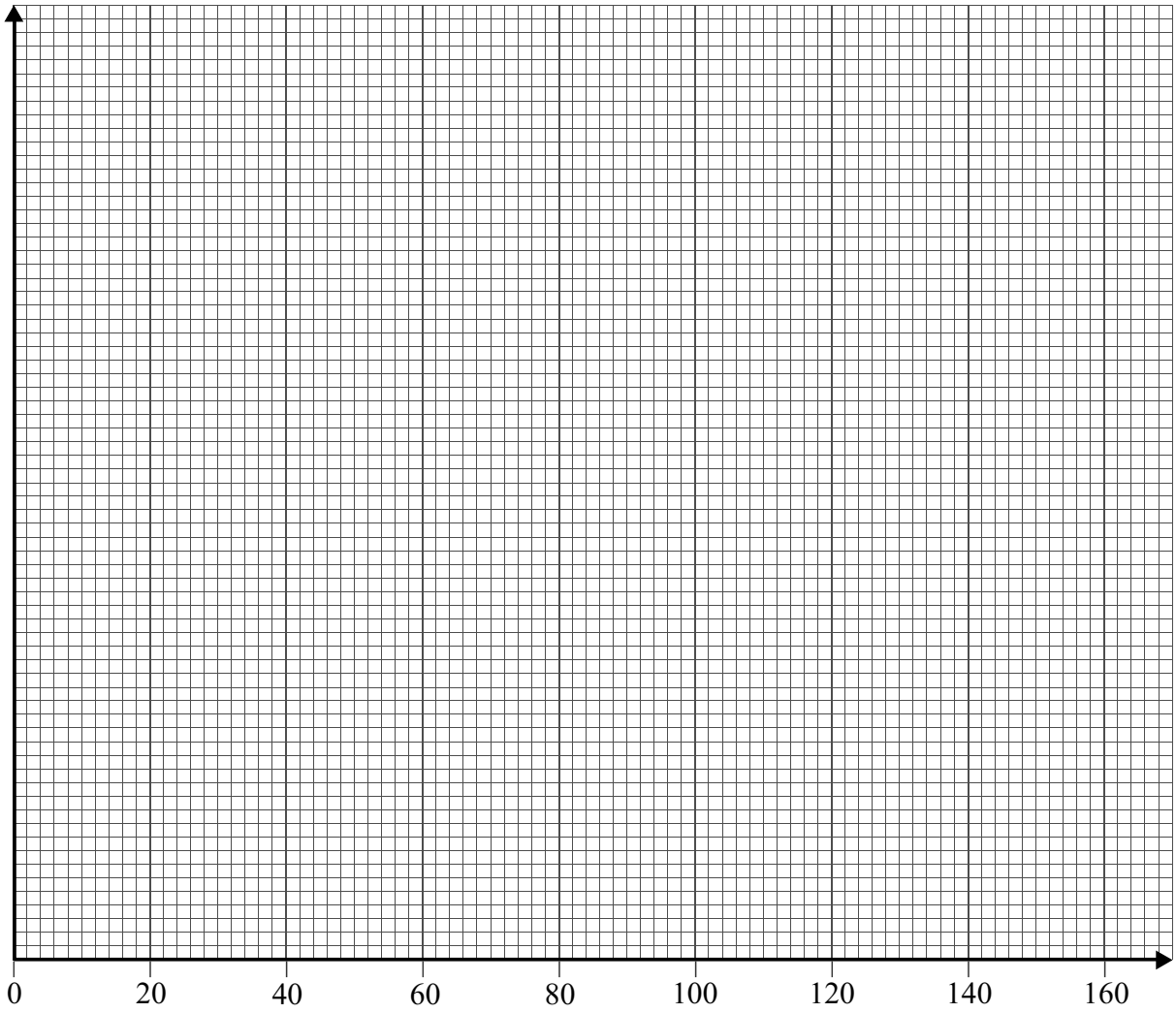
(e) **Using the grid on page 5**, draw a cascade (Gantt) diagram for the project. *(4 marks)*

(f) The gluing of the drawers actually takes 45 minutes.

Find the new minimum completion time for the project. *(2 marks)*

QUESTION PART REFERENCE

QUESTION PART REFERENCE



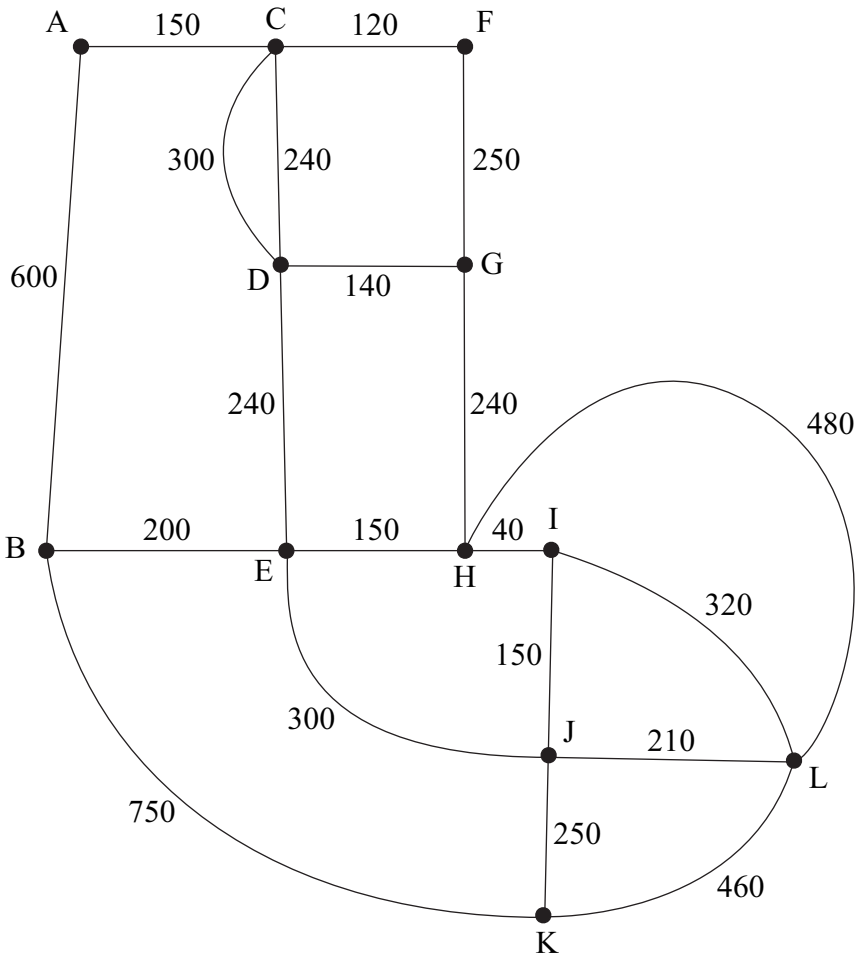
QUESTION PART REFERENCE

Section B

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

Use **Oxford** *on page 3 of the Data Sheet.*

2 The diagram shows a network of roads connecting some Oxford colleges. The number on each edge is the length, in metres, of the road.



(Total length of roads = 5590 metres)

(a) Stan has to walk along the roads shown, starting and finishing at A, to distribute leaflets.

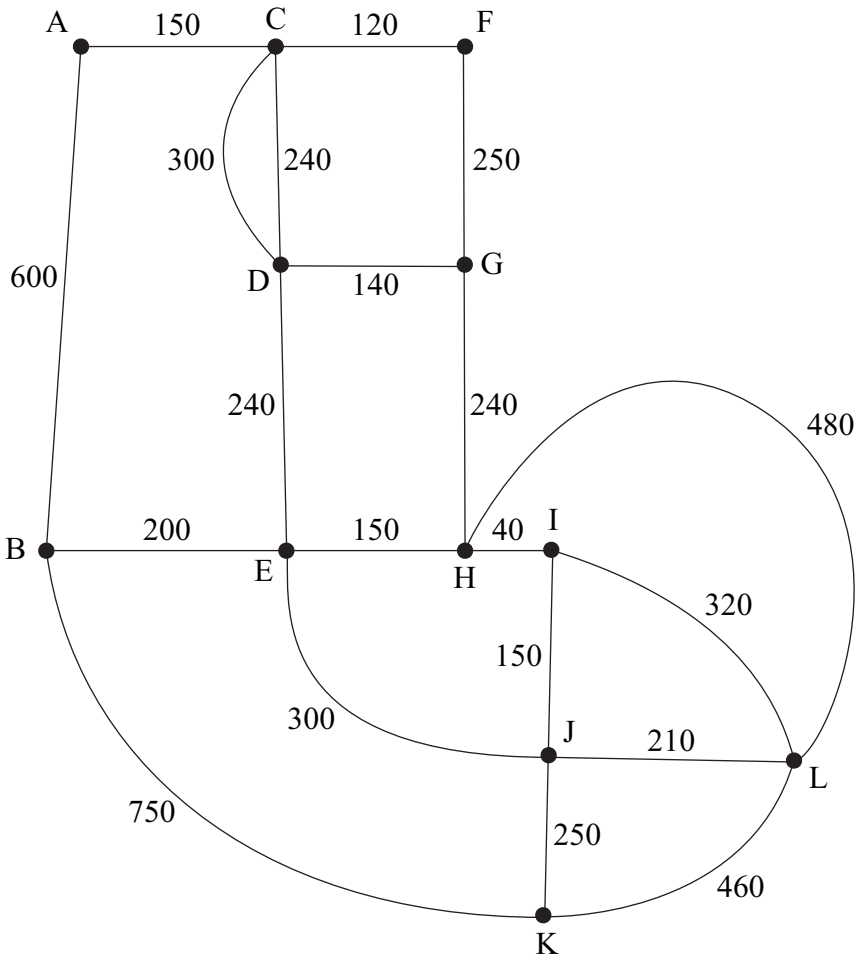
Use the Chinese Postman algorithm to find the length of an optimal route for Stan. Show all your working. *(7 marks)*

(b) Brian also wishes to distribute leaflets along the same roads. Brian can start at any point and finish at any point.

Find the minimum length of Brian's route. State the start and finish points corresponding to this minimum length. *(4 marks)*

QUESTION PART REFERENCE

3 Some of the colleges in Oxford are to be connected by a new computer-cabling system. The cabling is to be laid alongside the same roads as in question **2**.



(a) Showing the order in which you select the edges, use Kruskal's algorithm to find a minimum spanning tree for the 12 colleges. *(7 marks)*

(b) State the length of your minimum spanning tree. *(1 mark)*

(c) Draw your minimum spanning tree. *(3 marks)*

QUESTION PART REFERENCE

Section C

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

Use **Northern Ireland** *on page 4 of the Data Sheet.*

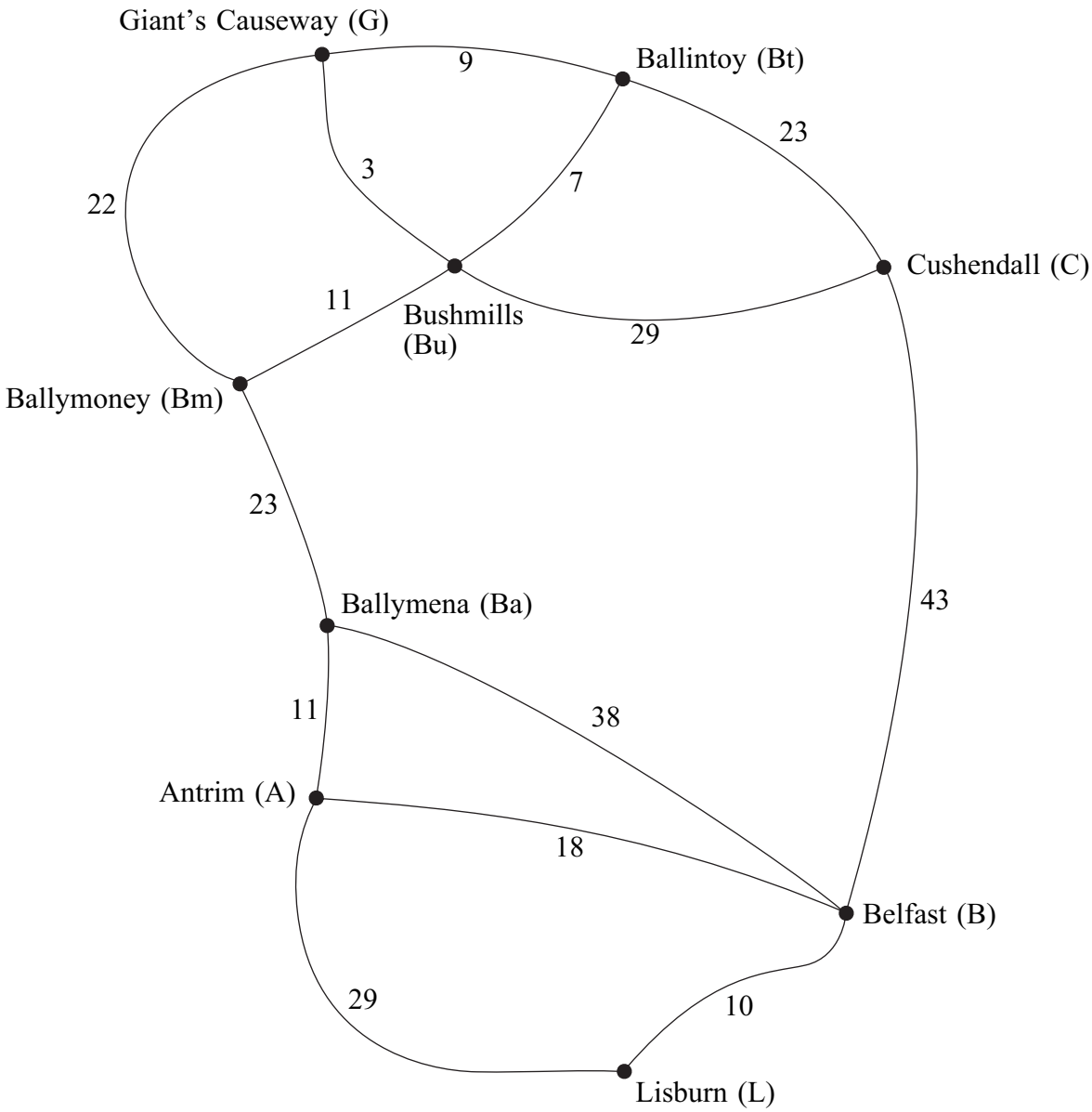
4 **The diagram opposite** shows a network of roads connecting nine places in Northern Ireland. The number on each edge is the length, in miles, of the road.

(a) Use Dijkstra's algorithm, **on the diagram opposite**, to find the shortest distance from Lisburn (L) to Giant's Causeway (G). Show all temporary labels. State the corresponding route. *(8 marks)*

(b) On a particular day, the only road that is open going into Giant's Causeway is from Ballintoy.

Find the minimum distance from Lisburn (L) to Giant's Causeway (G) on that day. *(2 marks)*

QUESTION PART REFERENCE



QUESTION PART REFERENCE

Section D

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

Use **Lo Zingaro** *on page 5 of the Data Sheet.*

5 The table shows the times, in seconds, to walk between the locations of five attractions in Lo Zingaro.

	A	**B**	**C**	**D**	**E**
A	–	480	540	280	470
B	480	–	460	380	700
C	540	460	–	560	400
D	280	380	560	–	600
E	470	700	400	600	–

Graham intends to walk from A to each of the other four locations before returning to A.

(a) Use the nearest neighbour algorithm, starting from A, to find an upper bound for Graham's minimum walking time. *(4 marks)*

(b) By deleting A, find a lower bound for Graham's tour. *(5 marks)*

(c) By considering your answers to parts **(a)** and **(b)**, write down a conclusion about the length of Graham's tour. *(1 mark)*

QUESTION PART REFERENCE

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END OF QUESTIONS

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