Edexcel GCE

Decision Mathematics D2

Advanced/Advanced Subsidiary

Wednesday 25 May 2005 − Afternoon

Time: 1 hour 30 minutes

Materials required for examination	**Items included with question papers**
Nil	D2 Answer booklet

Candidates may use any calculator EXCEPT those with the facility for symbolic algebra, differentiation and/or integration. Thus candidates must NOT use calculators such as the Texas Instruments TI 89, TI 92, Casio CFX 9970G, Hewlett Packard HP 48G.

Instructions to Candidates

In the boxes on the answer book, write your centre number, candidate number, your surname, initials and signature.

Information for Candidates

Full marks may be obtained for answers to ALL questions.
This paper has six questions. The total for this question is 75.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner. Answers without working may gain no credit.

Write your answers in the D2 answer booklet for this paper.

1. Freezy Co. has three factories *A*, *B* and *C*. It supplies freezers to three shops *D*, *E* and *F*. The table shows the transportation cost in pounds of moving one freezer from each factory to each outlet. It also shows the number of freezers available for delivery at each factory and the number of freezers required at each shop. The total number of freezers required is equal to the total number of freezers available.

	D	E	F	Available
A	21	24	16	24
B	18	23	17	32
C	15	19	25	14
Required	20	30	20	

(*a*) Use the north-west corner rule to find an initial solution.

(2)

(*b*) Obtain improvement indices for each unused route.

(5)
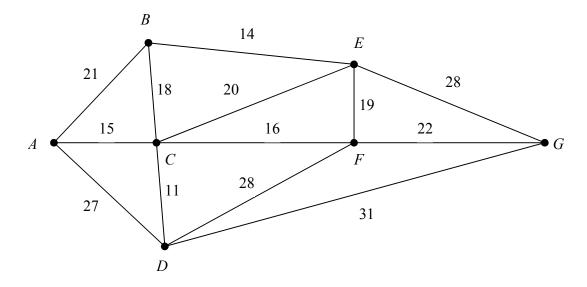
(*c*) Use the stepping-stone method **once** to obtain a better solution and state its cost.

(4)

(Total 11 marks)

2.

<div align="center">

Figure 1

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The network in Figure 1 shows the distances, in km, of the cables between seven electricity relay stations A, B, C, D, E, F and G. An inspector needs to visit each relay station. He wishes to travel a minimum distance, and his route must start and finish at the same station.

By deleting C, a lower bound for the length of the route is found to be 129 km.

(*a*) Find another lower bound for the length of the route by deleting F. State which is the better lower bound of the two.

(5)

(*b*) By inspection, complete the table of least distances.

(2)

The table can now be taken to represent a complete network.

(*c*) Using the nearest-neighbour algorithm, starting at F, obtain an upper bound to the length of the route. State your route.

(4)

(Total 11 marks)

3. Three warehouses *W*, *X* and *Y* supply televisions to three supermarkets *J*, *K* and *L*. The table gives the cost, in pounds, of transporting a television from each warehouse to each supermarket. The warehouses have stocks of 34, 57 and 25 televisions respectively, and the supermarkets require 20, 56 and 40 televisions respectively. The total cost of transporting the televisions is to be minimised.
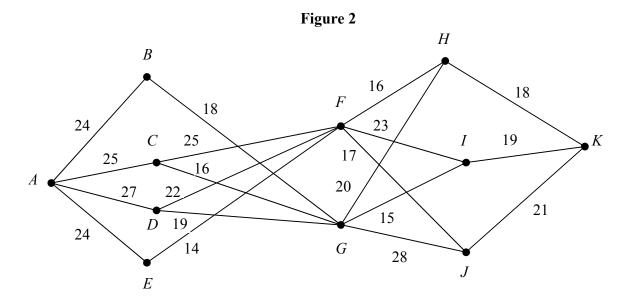
	J	K	L
W	3	6	3
X	5	8	4
Y	2	5	7

Formulate this transportation problem as a linear programming problem. Make clear your decision variables, objective function and constraints.

(Total 7 marks)

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4. (*a*) Explain what is meant by a maximin route in dynamic programming, and give an example of a situation that would require a maximin solution.

(3)

Figure 2

A maximin route is to be found through the network shown in Figure 2.

(*b*) Complete the table in the answer book, and hence find a maximin route.

(9)

(*c*) List **all** other maximin routes through the network.

(3)

(Total 14 marks)

5. Four salespersons *A*, *B*, *C* and *D* are to be sent to visit four companies 1, 2, 3 and 4. Each salesperson will visit exactly one company, and all companies will be visited.

Previous sales figures show that each salesperson will make sales of different values, depending on the company that they visit. These values (in £10 000s) are shown in the table below.

	1	2	3	4
Ann	26	30	30	30
Brenda	30	23	26	29
Connor	30	25	27	24
Dave	30	27	25	21

(*a*) Use the Hungarian algorithm to obtain an allocation that **maximises** the sales. You must make your method clear and show the table after each stage.

(11)

(*b*) State the value of the maximum sales.

(2)

(*c*) Show that there is a second allocation that maximises the sales.

(2)

(Total 15 marks)

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6. (*a*) Explain briefly what is meant by a **zero-sum** game.

(1)

A two person zero-sum game is represented by the following pay-off matrix for player *A*.

	I	II	III
I	5	2	3
II	3	5	4

(*b*) Verify that there is no stable solution to this game.

(3)

(*c*) Find the best strategy for player *A* and the value of the game to her.

(8)

(*d*) Formulate the game as a linear programming problem for player *B*. Write the constraints as inequalities and define your variables clearly.

(5)

(Total 17 marks)

TOTAL FOR PAPER: 75 MARKS

END