

Paper Reference(s)

6690/01

Edexcel GCE

Decision Mathematics D2

Advanced/Advanced Subsidiary

Sample Assessment Material

Time: 1 hour 30 minutes

Materials required for examination

Nil

Items included with question papers

D2 Answer Book

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions to Candidates

Write your answers for this paper in the D2 answer book provided.

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

Check that you have the correct question paper.

When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Do not return the question paper with the answer book.

Information for Candidates

Full marks may be obtained for answers to ALL questions.

The marks for individual questions and the parts of questions are shown in round brackets: e.g. (2).

There are 8 questions in this question paper. The total mark for this question paper is 75.

There are 8 pages in this question paper. The answer book has 8 pages. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.

You should show sufficient working to make your methods clear to the examiner.

Answers without working may not gain full credit.

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Turn over

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

1.

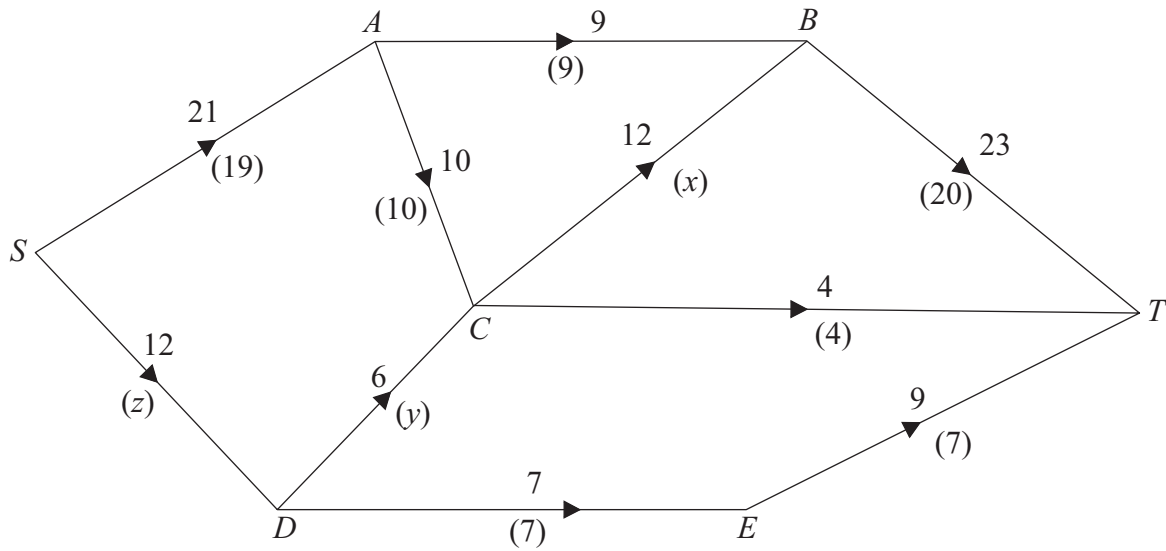


Figure 1

Figure 1 shows a directed, capacitated network where the number on each arc is its capacity. A possible flow is shown from S to T and the value in brackets on each arc is the flow in that arc.

(a) Find the values of x , y , and z . (3)

(b) Find, by inspection, the maximal flow from S to T and verify that it is maximal. (2)

(Total 5 marks)

2. A three-variable linear programming problem in x , y and z is to be solved. The objective is to maximise the profit P . The following initial tableau was obtained.

Basic variable	x	y	z	r	s	Value
r	2	0	4	1	0	80
s	1	4	2	0	1	160
P	-2	-8	-20	0	0	0

- (a) Taking the most negative number in the profit row to indicate the pivot column, perform one complete iteration of the simplex algorithm, to obtain tableau T . State the row operations that you use.

(5)

- (b) Write down the profit equation shown in tableau T .

(1)

- (c) State whether tableau T is optimal. Give a reason for your answer.

(1)

(Total 7 marks)

3. 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)

4.

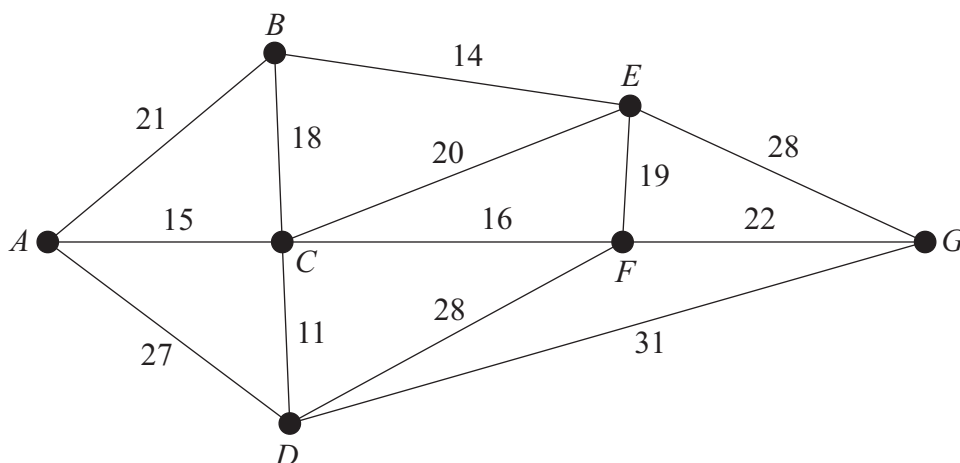


Figure 2

The network in Figure 2 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 best 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)

5. 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 6 marks)

6.

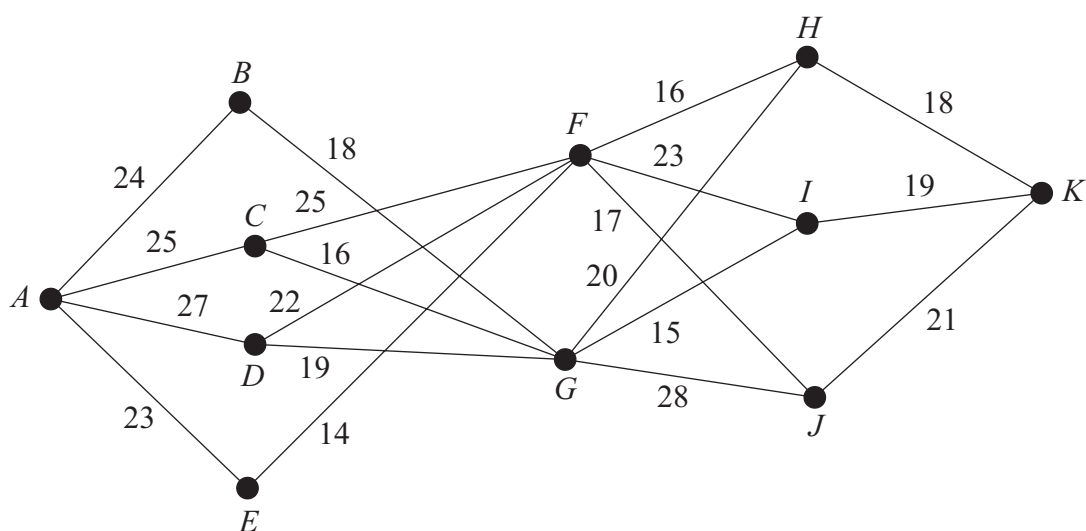


Figure 3

A maximin route is to be found through the network shown in Figure 3.

Complete the table in the answer book, and hence find a maximin route.

(Total 9 marks)

7. 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)

8. 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

- (a) Verify that there is no stable solution to this game. (3)
- (b) Find the best strategy for player A and the value of the game to her. (8)

(Total 11 marks)

TOTAL FOR PAPER: 75 MARKS

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