Pearson Edexcel Level 3

GCE Further Mathematics

Advanced Subsidiary

Decision Mathematics 2

Specimen paper **Time: 50 minutes**	**Paper Reference(s)** **8FM0/28**

You must have:
Mathematical Formulae and Statistical Tables, calculator

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need*.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 4 questions in this section of the paper. The total mark is 40.
- The marks for each question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Answer ALL questions. Write your answers in the answer book provided.

1. The table below is a cost matrix for an allocation problem. The total cost is to be minimised.

Each of workers *A*, *B*, *C* and *D* must be assigned to exactly one of tasks *P*, *Q*, *R* and *S*.

It is not possible to assign *B* to *R* or *C* to *S*.

	P	*Q*	*R*	*S*
A	7	8	18	6
B	8	21	–	12
C	6	17	9	–
D	16	20	13	11

(a) The table must be adapted before the Hungarian algorithm can be applied.

(i) Explain how to adapt the table.

(ii) Explain why this adaptation allows the algorithm to be used to solve the problem.

(2)

(b) Reducing rows first, use the Hungarian algorithm to obtain an allocation which minimises the total cost. You must

(i) show the table after each stage,
(ii) explain how you know whether you have reached an optimal result,
(iii) state the final minimum cost.

(6)

(Total for Question 1 is 8 marks)

2. (a) In the context of game theory, explain what the term "play safe strategy" means.

(2)

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

	B plays 1	*B* plays 2
A plays 1	−4	3
A plays 2	4	−2
A plays 3	2	−1

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

(2)

(c) (i) Find the best strategy for player *B*, defining any variables you use.

(ii) Find the value of the game to player *A*.

(8)

(Total for Question 2 is 12 marks)

3.

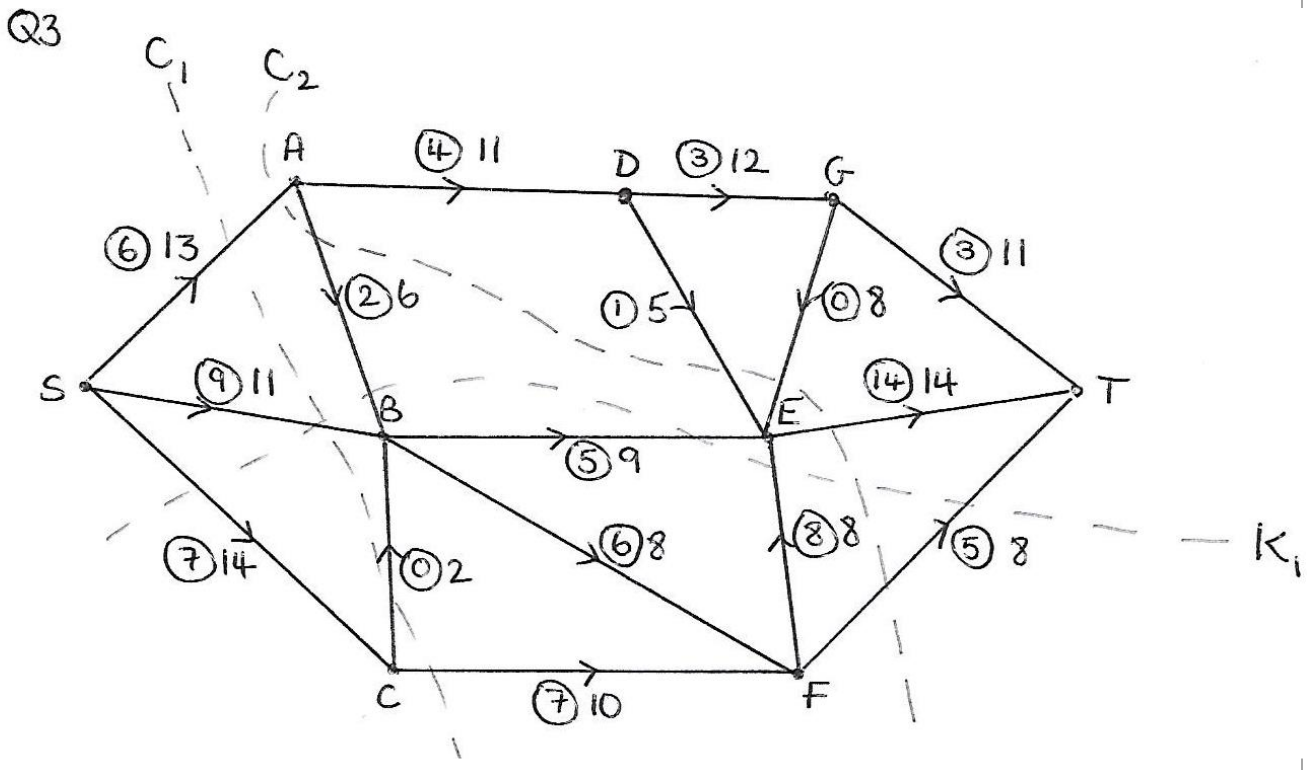

Figure 1

Figure 1 shows a capacitated, directed network. The number on each arc is the capacity of that arc. The numbers in circles represent an initial flow from S to T.

(a) Explain why the dotted line marked K_1 in Figure 1 is not a cut.

(1)

Two cuts C_1 and C_2 are shown in Figure 1.

(b) Write down

(i) the capacity of each of the two cuts C_1 and C_2

(ii) the value of the initial flow.

(3)

(c) Complete the initialisation of the labelling procedure on Diagram 1 in the answer book by entering values along arcs SA, AD, DE, GE and GT.

(2)

(d) Hence use the labelling procedure to find a maximal flow pattern for the network. You must

(i) list each flow-augmenting path you use, together with its flow,

(ii) show your maximal flow pattern on Diagram 2 in the answer book.

(4)

(e) (i) State the value of the maximal flow,

(ii) prove that your flow is maximal.

(3)

(Total for Question 3 is 13 marks)

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4. Rebecca invests a sum of money in a savings account which earns 3% interest per annum. At the end of each year, she withdraws £600 to pay for her grandson's music lessons for the following year.

Let x_n represent the amount remaining in the account at the end of the nth year, after the interest for the year has been paid and £600 has been withdrawn.

This information is represented by the recurrence relation

$$x_n = 1.03x_{n-1} - 600, \quad n \geq 1.$$

(a) Find a general solution for this recurrence relation.

(3)

Given that Rebecca invested £4000 into the account at the start of the first year,

(b) use this information to find a particular solution for this recurrence relation.

(1)

(c) Find the year in which the funds in the account at the end of the year fall below £600.

(3)

(Total for Question 4 is 7 marks)

TOTAL FOR SECTION IS 40 MARKS