Pearson Edexcel Level 3 GCE

Friday 16 May 2025

Afternoon

Paper reference **8FM0/28**

Further Mathematics

Advanced Subsidiary
Further Mathematics options
28: Decision Mathematics 2
(Part of option K only)

You must have:
Mathematical Formulae and Statistical Tables (Green), calculator,
D2 Answer Book (enclosed)

Candidates may use any calculator allowed by Pearson regulations. Calculators must not have the facility for symbolic algebra 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).
- **Fill in the boxes** at the top of the answer book with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the answer book 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.
- Do not return the question paper with the D2 Answer Book.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- The total mark for this part of the examination is 40. There are 4 questions.
- 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.

Turn over ▶

P74076A

Y:1/1/1/

P 7 4 0 7 6 A

Pearson

1. Five workers, A, B, C, D and E, are each to be assigned to one of five tasks, J, K, L, M and N. Each task must be assigned to exactly one worker and each worker must do exactly one task.

Worker C cannot do task L and worker D cannot do task K.

The profit, in pounds, that each worker will make while assigned to each task is shown in the table below.

	J	K	L	M	N
A	38	33	40	35	32
B	26	24	27	25	23
C	33	29	–	30	27
D	36	–	41	37	33
E	32	27	31	29	25

The Hungarian algorithm is to be used to find the maximum total profit that can be earned by the five workers.

(a) Explain how the contents of the table must be modified to allow the algorithm to be used.

(2)

(b) Reducing rows first, use the Hungarian algorithm to obtain the maximum total profit. You should explain how any initial row and column reductions are made and also how you determine if the table is optimal at each stage.

(7)

(Total for Question 1 is 9 marks)

2.

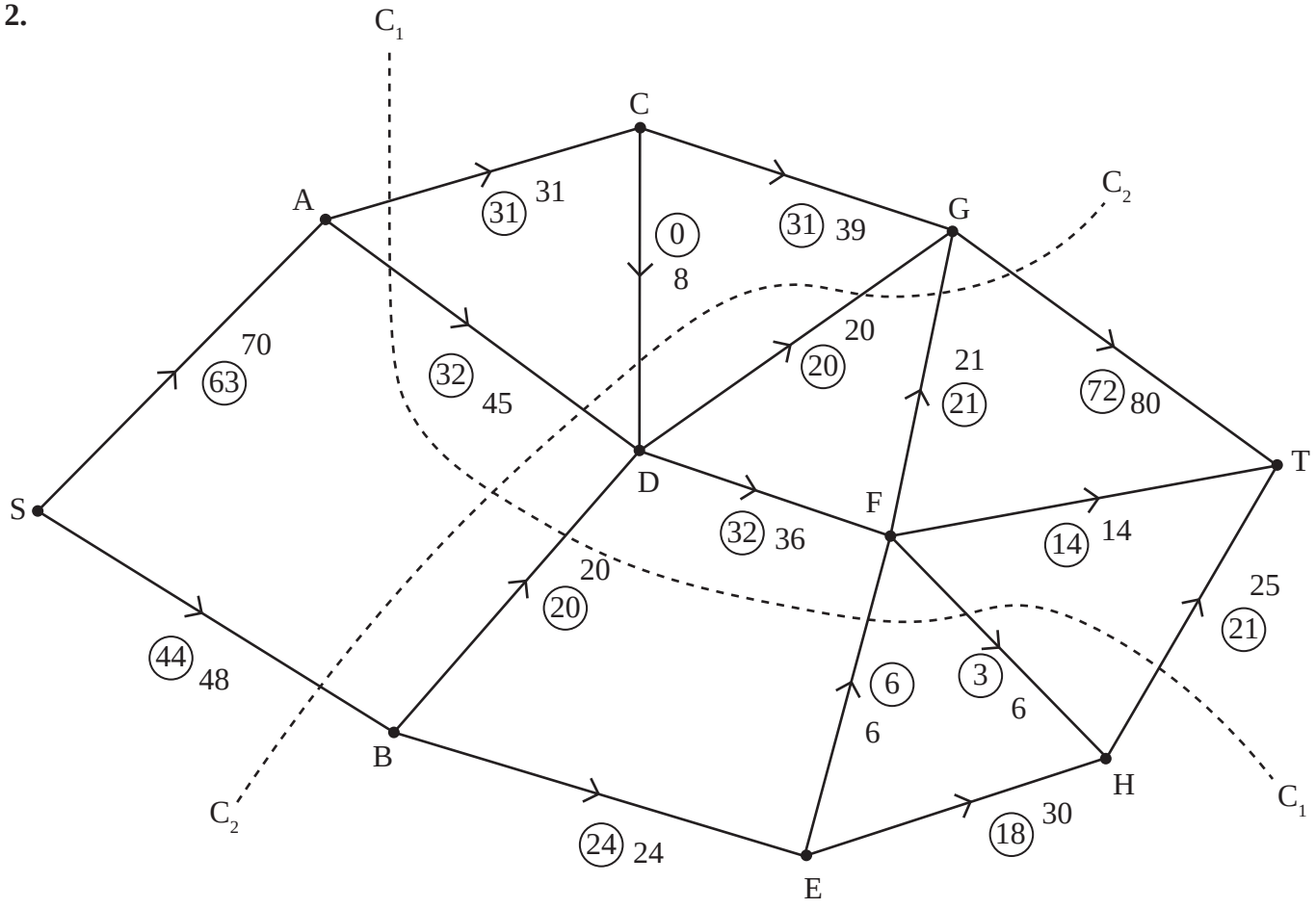

Figure 1

Figure 1 shows a capacitated, directed network of pipes. The number on each arc represents the capacity of the corresponding pipe. The numbers in circles represent a feasible flow from S to T.

(a) State the two conditions satisfied by a feasible flow.

(2)

(b) List the seven saturated arcs in Figure 1.

(1)

(c) Find the capacity of

(i) cut C_1

(ii) cut C_2

(2)

(d) Write down a flow-augmenting route that increases the flow by four units.

(1)

(e) Use the answer to part (d) to draw the resulting flow pattern on Diagram 1 in the answer book.

(2)

(f) Prove that the answer to part (e) is a maximum flow.

(3)

(Total for Question 2 is 11 marks)

3. Layla and Mohsin play a zero-sum game represented by the following pay-off matrix for Layla.

	Mohsin plays X	Mohsin plays Y	Mohsin plays Z
Layla plays P	1	−2	2
Layla plays Q	−4	3	−5
Layla plays R	−1	1	−3

(a) (i) Find the play-safe strategies for each player.

(ii) State, giving a reason, whether there is a stable solution to this game.

(3)

(b) Option R is now removed from Layla's choices.

(i) For each of Mohsin's three options, find the expected pay-off to Layla when she plays options P and Q equally often.

(1)

(ii) Use a graphical method to determine Layla's optimal mixed strategy. You should define any variables you use.

(7)

(Total for Question 3 is 11 marks)

---

4. A sequence $\{u_n\}$, where $n \geqslant 1$, satisfies the recurrence relation

$$4u_{n+1} + 2u_n = 3n - 5$$

Given that $u_1 = -2$

(a) solve the recurrence relation, giving u_n in terms of n

(6)

(b) hence determine the number of negative terms in the sequence $\{u_n\}$. You must justify your answer.

(3)

(Total for Question 4 is 9 marks)

TOTAL FOR DECISION MATHEMATICS 2 IS 40 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 3 GCE

Friday 16 May 2025

Afternoon

Paper reference **8FM0/28**

Further Mathematics

Advanced Subsidiary
Further Mathematics options
28: Decision Mathematics 2
(Part of option K only)

D2 Answer Book

Do not return the question paper with the answer book.

Total Marks

Turn over ▶

P74076A

Y:1/1/1/

P 7 4 0 7 6 A 0 1 1 2

Pearson

1.

	J	K	L	M	N
A	38	33	40	35	32
B	26	24	27	25	23
C	33	29	–	30	27
D	36	–	41	37	33
E	32	27	31	29	25

You may not need to use all of these tables.

	J	K	L	M	N
A					
B					
C					
D					
E					

	J	K	L	M	N
A					
B					
C					
D					
E					

	J	K	L	M	N
A					
B					
C					
D					
E					

Question 1 continued

	J	K	L	M	N
A					
B					
C					
D					
E					

	J	K	L	M	N
A					
B					
C					
D					
E					

	J	K	L	M	N
A					
B					
C					
D					
E					

	J	K	L	M	N
A					
B					
C					
D					
E					

	J	K	L	M	N
A					
B					
C					
D					
E					

(Total for Question 1 is 9 marks)

2.

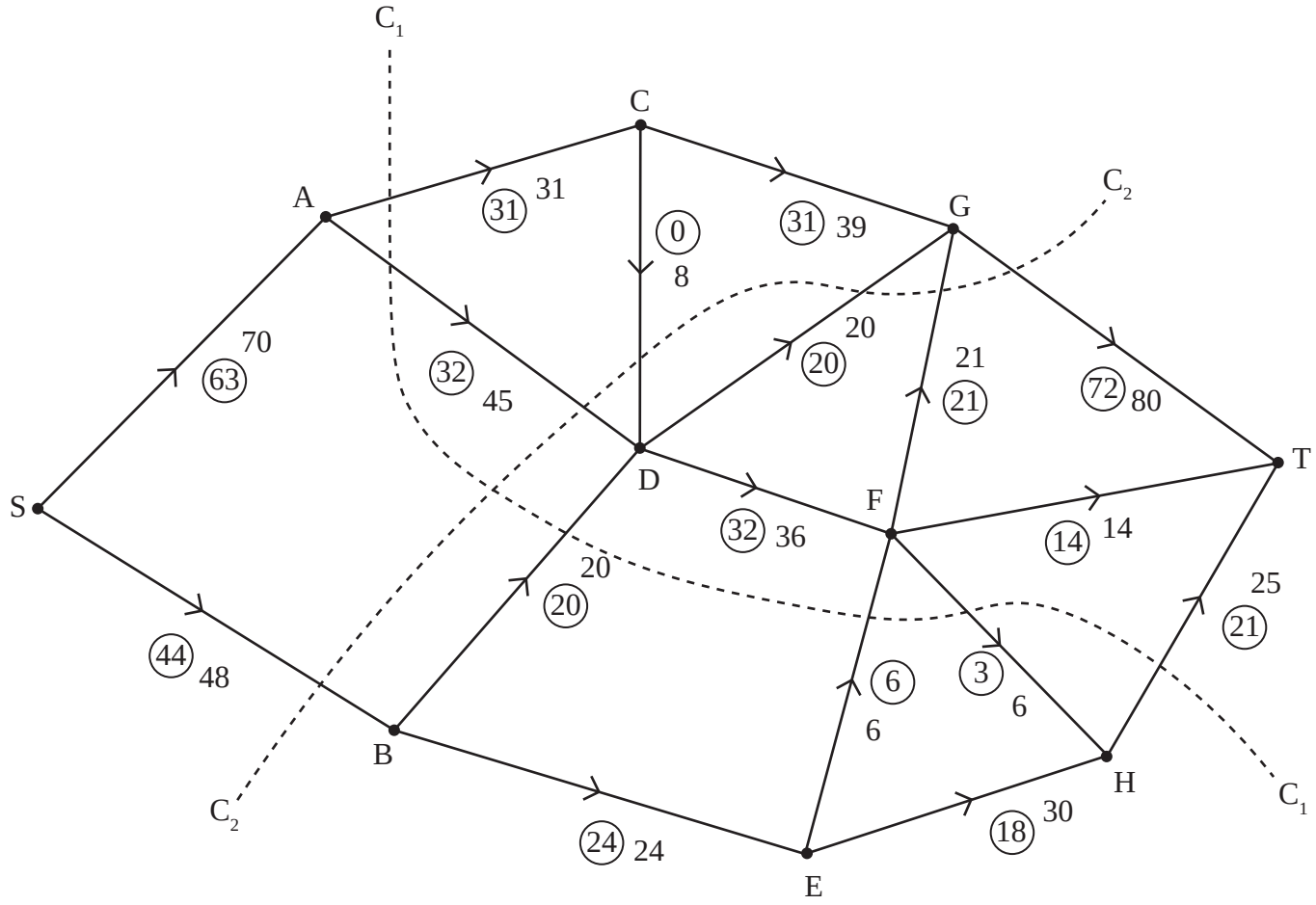

Figure 1

Question 2 continued

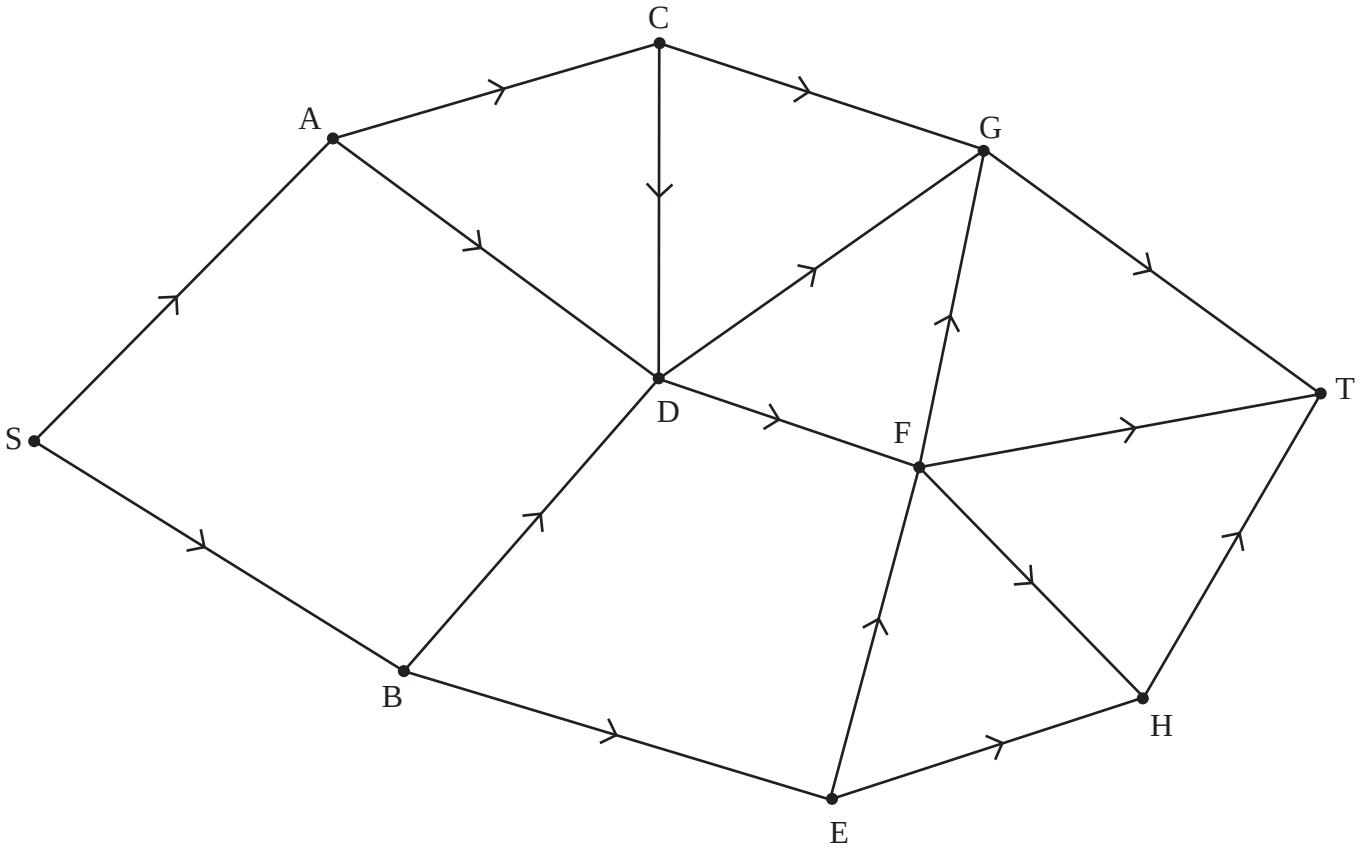

Diagram 1

(Total for Question 2 is 11 marks)

3.

	Mohsin plays X	Mohsin plays Y	Mohsin plays Z
Layla plays P	1	–2	2
Layla plays Q	–4	3	–5
Layla plays R	–1	1	–3

Question 3 continued

Question 3 continued

Question 3 continued

(Total for Question 3 is 11 marks)

4.

Question 4 continued

Question 4 continued

(Total for Question 4 is 9 marks)

TOTAL FOR DECISION MATHEMATICS 2 IS 40 MARKS