



Rewarding Learning

General Certificate of Secondary Education
2024

Centre Number

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Candidate Number

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Further Mathematics

Unit 4 (With calculator)

Discrete and
Decision Mathematics



[GFM41]

GFM41

FRIDAY 21 JUNE, MORNING

TIME

1 hour.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page.

Complete in black ink only. **Do not write with a gel pen.**

All working **must** be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.

Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 50.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

You may use a calculator.

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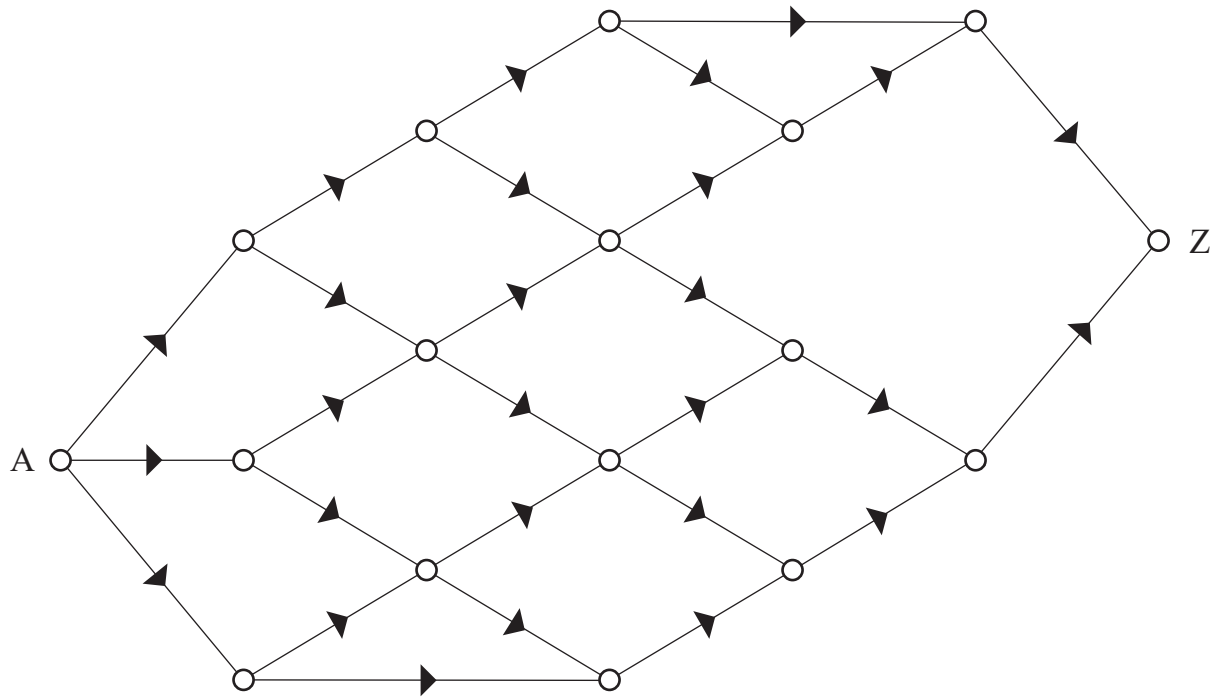
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20GFM4102



1 A network of one-way connections flows from A to Z, as shown in the diagram below.



How many different routes from A to Z are possible?

Answer _____ [3]

[Turn over



2 Tara is employed as a care assistant in a nursing home.

She is required to work both night shifts and day shifts.

Tara earns £96 for a night shift lasting 10 hours and £72 for a day shift lasting 8 hours.

Each month Tara works x night shifts and y day shifts.

She must work at least 6 night shifts per month.

(i) Express this condition as an inequality.

Answer _____ [1]

She must not work more than 176 hours per month.

(ii) Show that $5x + 4y \leq 88$

[1]



Tara is guaranteed to earn at least £1440 per month.

(iii) Show that $4x + 3y \geq 60$

[1]

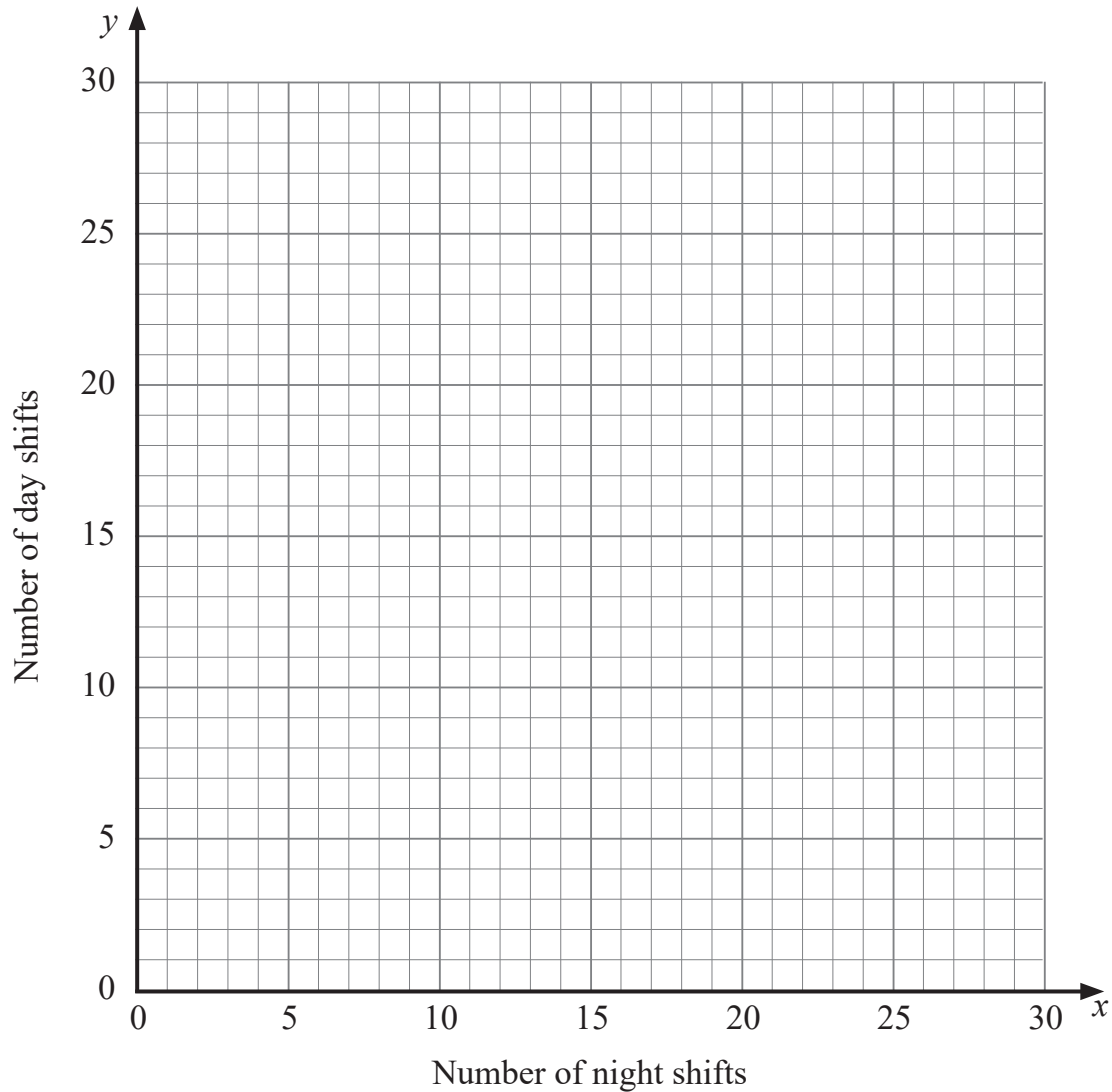
[Turn over



The number of night shifts worked must not be greater than twice the number of day shifts worked. This can be expressed as

$$x \leq 2y$$

(iv) Illustrate the four inequalities by a suitable diagram on the graph below.



Identify with the letter **R** the region containing the set of points satisfying all four inequalities.

[4]



From your solution set, find

(v) the minimum total number of shifts that Tara can work in a month,

Answer _____ [2]

(vi) the minimum total number of hours that Tara can work to earn exactly £1440 in a month,

Answer _____ hours [2]

Q2 continues on page 9

[Turn over



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(vii) Tara's maximum possible earnings in a month.

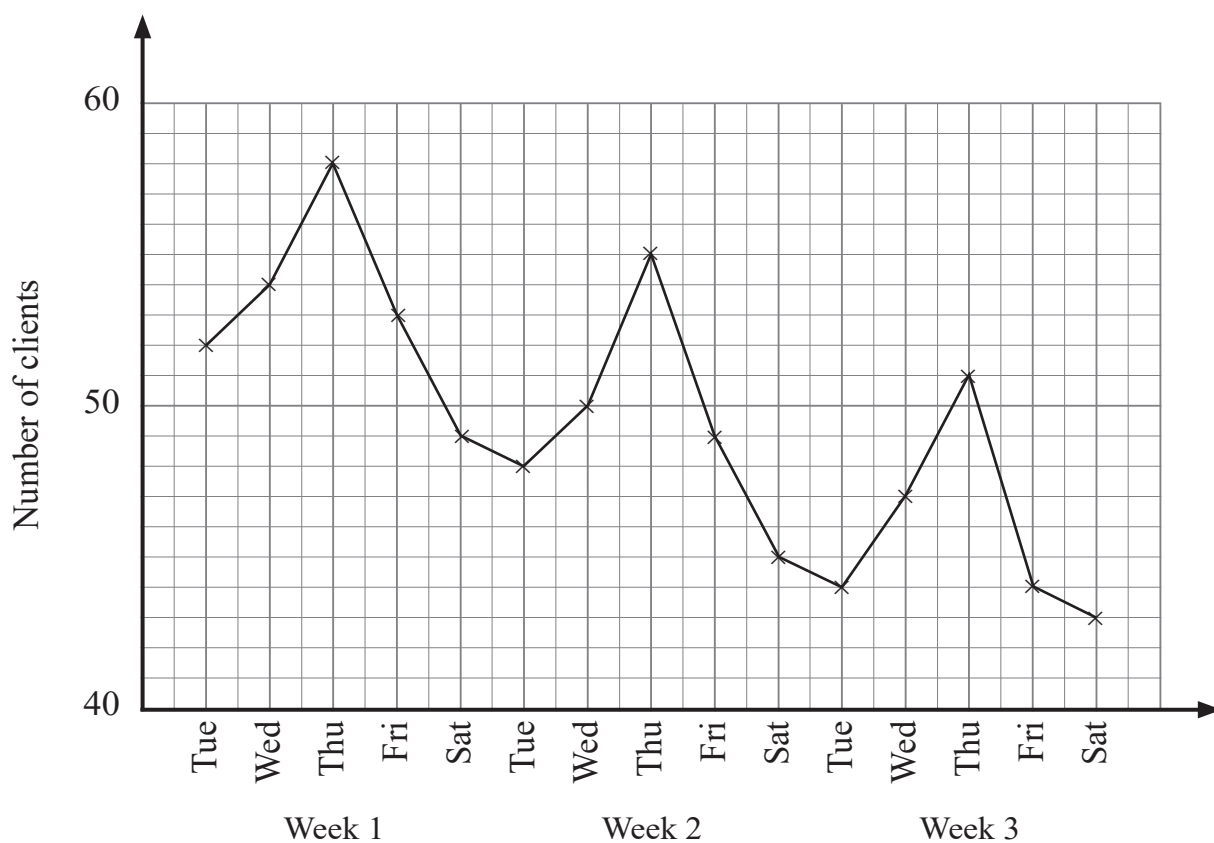
Answer £ _____ [2]



- 3 The table below shows the number of clients attending a popular hair and beauty salon in Belfast during the first three weeks in a month.

	Tuesday	Wednesday	Thursday	Friday	Saturday
Week 1	52	54	58	53	49
Week 2	48	50	55	49	45
Week 3	44	47	51	44	43

These data have been plotted on the graph below.



- (i) Calculate appropriate moving averages to smooth the data, using the information below.

Give your answers to 3 significant figures where necessary.

52

54

58

53

49

48

50

55

49

45

44

47

51

44

43

[2]

- (ii) Plot these averages on the graph opposite and draw the trend line.

[3]

Q3 continues on page 13

[Turn over



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(iii) Showing clearly where any reading is taken, use the trend line to calculate an estimate of the number of clients likely to attend the salon on Tuesday of Week 4

Answer _____ [3]

(iv) State briefly the assumption made when using this trend line for estimating future attendances at the salon.

Answer _____
_____ [1]

[Turn over



4 The **NOR** operation joining two Boolean variables p and q is defined by

$$p \text{ NOR } q \equiv \text{NOT } (p \text{ or } q)$$

(i) By filling in the truth table below, show that

$$p \text{ NOR } q \equiv (\text{NOT } p) \text{ and } (\text{NOT } q)$$

p	q	$p \text{ or } q$	$\text{NOT } (p \text{ or } q)$	$\text{NOT } p$	$\text{NOT } q$	$(\text{NOT } p) \text{ and } (\text{NOT } q)$
T	T					
T	F					
F	T					
F	F					

[5]

The Boolean variables a and b are defined by

$a \equiv$ “Alain plays table tennis” and $b \equiv$ “Brian likes ice cream”

(ii) Write, using the Boolean variables a and b , the sentence

“It is not true that both Alain doesn’t play table tennis
and Brian doesn’t like ice cream”

Answer _____ [2]



(iii) Using part (i), write an English sentence that is equivalent in meaning to the sentence in part (ii), but expressed more simply.

Answer _____
_____ [3]



5 A subject choice sheet for AS Level study at St Olaf's College is listed below.

A	B	C
English	Spanish	Economics
Mathematics	Chemistry	French
Physics	Computing	History
Geography	Social Care	Politics
Psychology	Business Studies	Further Mathematics
	German	Biology
		Sociology
		Art and Design
		Technology

If a student wishes to study four subjects, they must pick one subject from each of columns **A** and **B** and two subjects from column **C**.

(i) How many different combinations of four subjects may a student pick from?

Answer _____ [1]



If a student wishes to study three subjects, they must pick:

- one subject from each of columns **A**, **B** and **C**,
- or
- one subject from column **A** and two subjects from column **C**,
- or
- one subject from column **B** and two subjects from column **C**.

(ii) How many different combinations of three subjects may a student pick from?

Answer _____ [4]

[Turn over



- 6 (a) The activity network for a project to arrange a charity ball is described by the precedence table below.

Activity	Prerequisite activities
A	None
B	None
C	A
D	B
E	B
F	C, D
G	E

Draw the activity network corresponding to this precedence table in the space below.

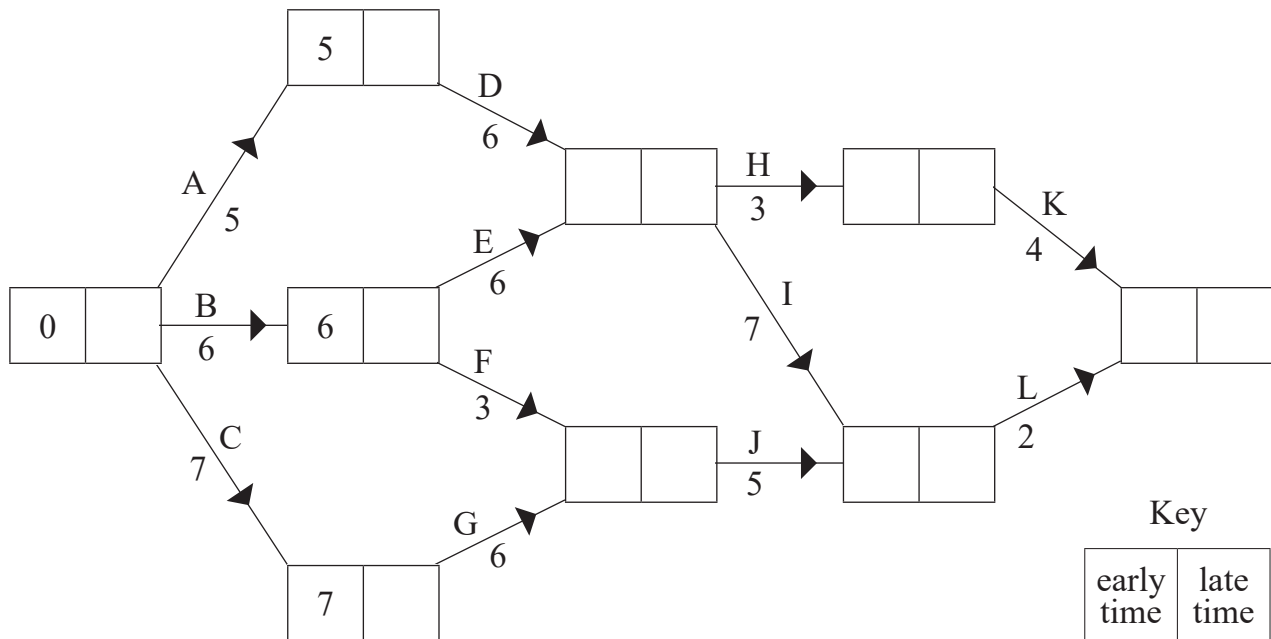
[2]



(b) The diagram below shows the activity network used to model an advertising project.

The activities involved are labelled A, B, C, D, E, F, G, H, I, J, K and L. These activities are represented by the edges.

The number on each edge represents the time in days required to complete that activity.



(i) Complete the diagram above by filling in the missing early times and late times. [6]

(ii) List the critical activities and determine the length of the critical path.

Answer Critical activities _____ [1]

Length of critical path _____ days [1]



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For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	

Total Marks	
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Examiner Number

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