Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2019

Further Mathematics

Unit 4
Discrete and
Decision Mathematics

[GFM41]

GFM41

THURSDAY 20 JUNE, AFTERNOON

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 seven** 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.

1 An orchestra admits new members who have the skill to play three instruments, one chosen from **each** of the following groups.

Group 1		Group 2		Group 3
flute oboe bassoon tuba	and	trumpet trombone clarinet cello French horn	and	violin viola saxophone

How many different combinations of skills are possible for new members?

Answer _____ [2]

2 Complete the truth table below to prove that the statements

(p **or not** q) **and** r and (p **and** r) **or** (**not** q **and** r)

are equivalent.

p	q	r	**not** q	p **or not** q	(p **or not** q) **and** r	p **and** r	**not** q **and** r	(p **and** r) **or** (**not** q **and** r)
T	T	T						
T	T	F						
T	F	T						
T	F	F						
F	T	T						
F	T	F						
F	F	T						
F	F	F						

[4]

[Turn over

3 Paula, the manager of a hotel, is organising staff to act as servers at a wedding reception.

She will use x full-time workers from the hotel and call in y part-time workers to make up the number of servers who will be employed at the reception.

Each full-time worker will earn £100 and each part-time worker will earn £60

(i) The selection of servers is subject to four restrictions:

(1) At least 16 servers will be required.

(a) Express this condition as an inequality.

Answer _____ [1]

(2) The total amount paid to servers must not exceed £1500

(b) Show that $5x + 3y \leq 75$

[1]

(3) There must be at least one full-time worker for every two part-time workers,

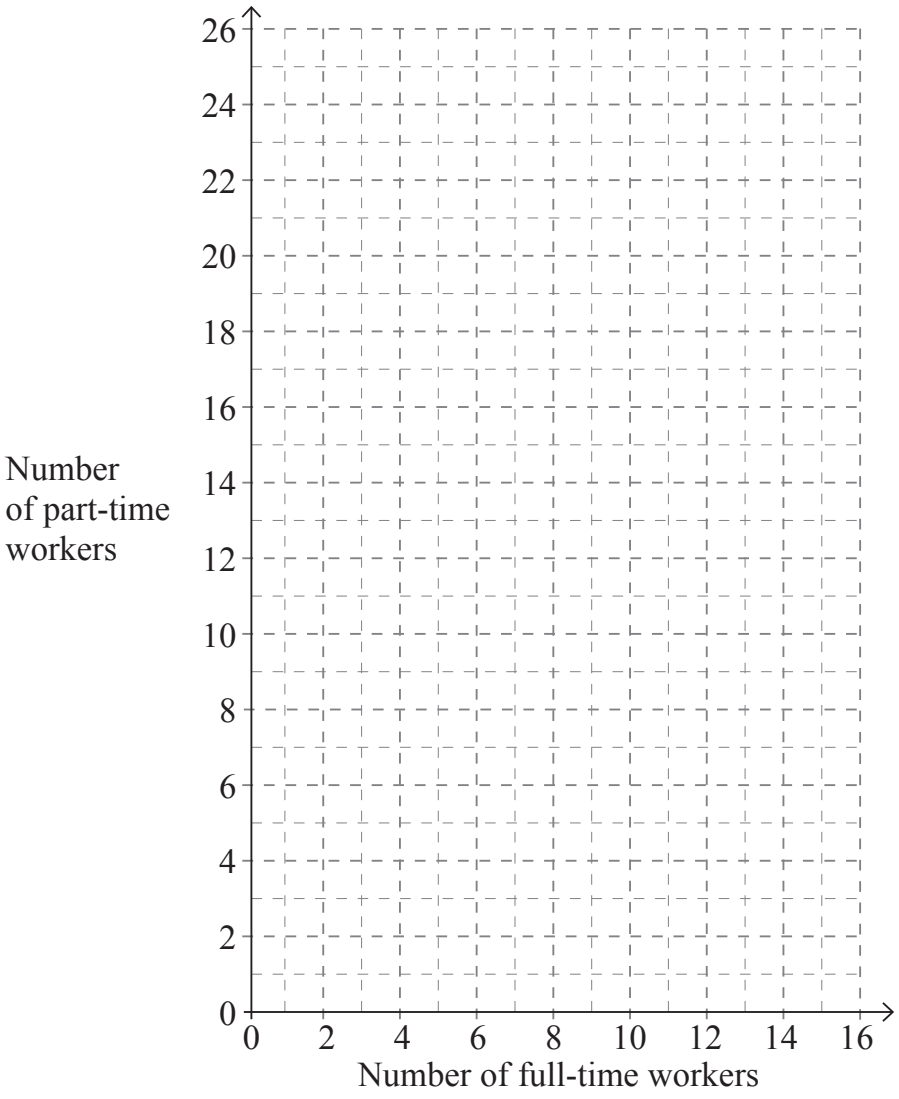
$$\text{i.e. } x \geq \frac{y}{2}$$

(4) No more than 10 full-time workers will be available,

$$\text{i.e. } x \leq 10$$

(ii) 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]

[Turn over

Use your solution set to find

(iii) the minimum number and the maximum number of part-time workers who may be employed,

Answer Minimum number _____ [1]

Maximum number _____ [1]

(iv) the maximum total number of servers who could be employed at the reception,

Answer _____ [1]

(v) the amount by which Paula is below her spending limit of £1500 if she employs the maximum total number of servers.

Answer £ _____ [2]

[Turn over

4 The letters p and q represent two statements, each of which may be true or false.

(i) By completing the truth table below, express the compound statement

(p **and not** q) **or** (**not** p **and** q) **or** (p **and** q)

by a simple statement involving one occurrence each of p and q.

p	q	**not** p	**not** q	p **and not** q	**not** p **and** q	p **and** q	**Compound statement**
T	T						
T	F						
F	T						
F	F						

Answer Simple Statement _____ [5]

(ii) **Hence** suggest a simpler statement equivalent to:

Freda feels cold and Geoff doesn't feel hungry,

or Freda doesn't feel cold and Geoff feels hungry,

or Freda feels cold and Geoff feels hungry.

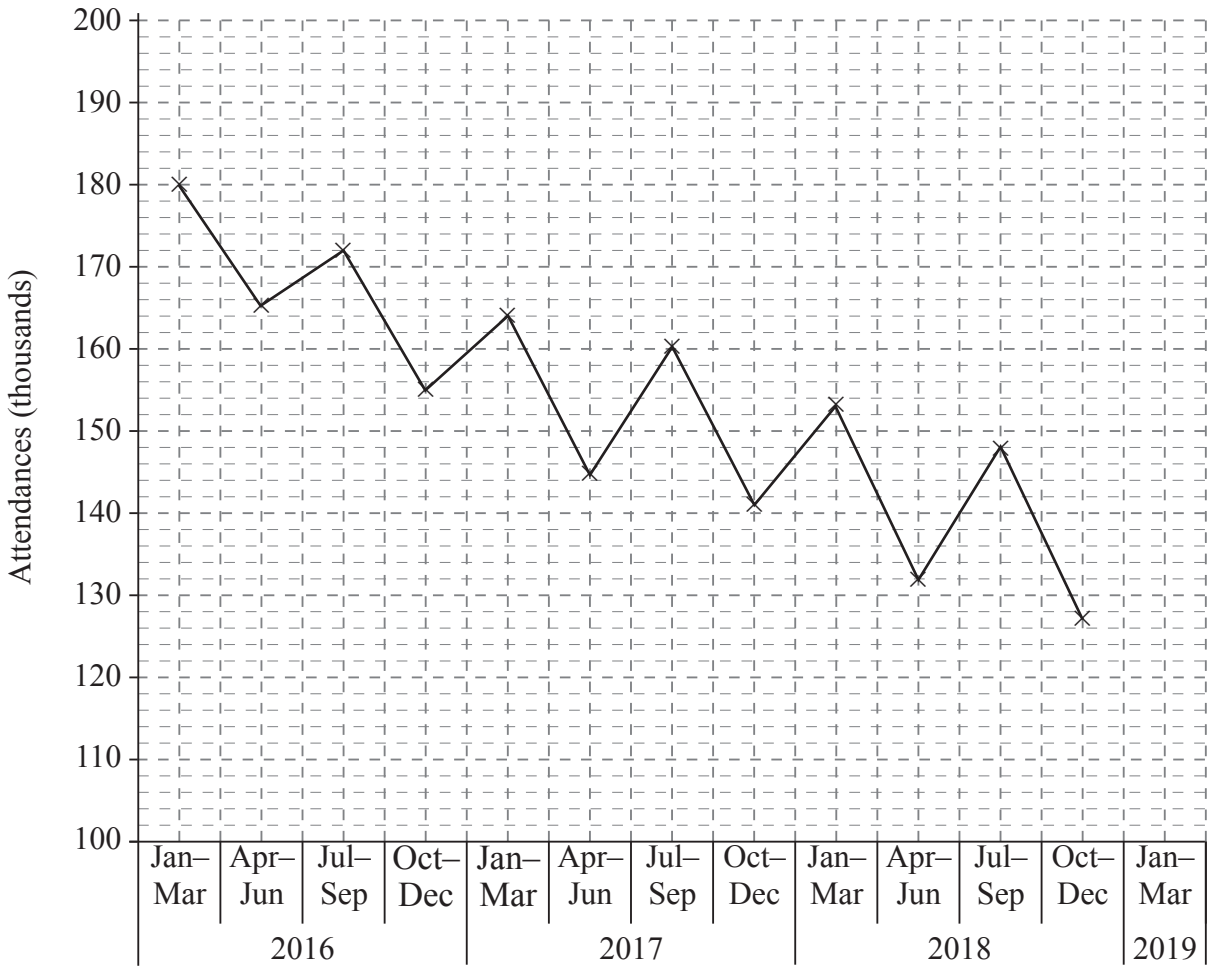
Answer _____

_____ [1]

5 Ciaran, a manager at a local leisure centre complex, recorded the attendances (in thousands) over a three-year period. The attendances for 2016–2018 are summarised in the table below.

Year	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec
2016	180	165	172	155
2017	164	145	160	141
2018	153	132	148	127

These data have been plotted on the graph below.



(i) Calculate 4-point moving averages to smooth the data, using the information below.

180

165

172

155

164

145

160

141

153

132

148

127

[2]

(ii) Plot these averages on the graph opposite and draw the trend line. [3]

(iii) Showing clearly where any reading is taken, use the trend line to estimate the leisure centre complex attendance for the first quarter of **2019**.

Answer _____ [3]

(iv) State briefly the assumption made when using a trend line for estimating future values.

Answer _____

_____ [1]

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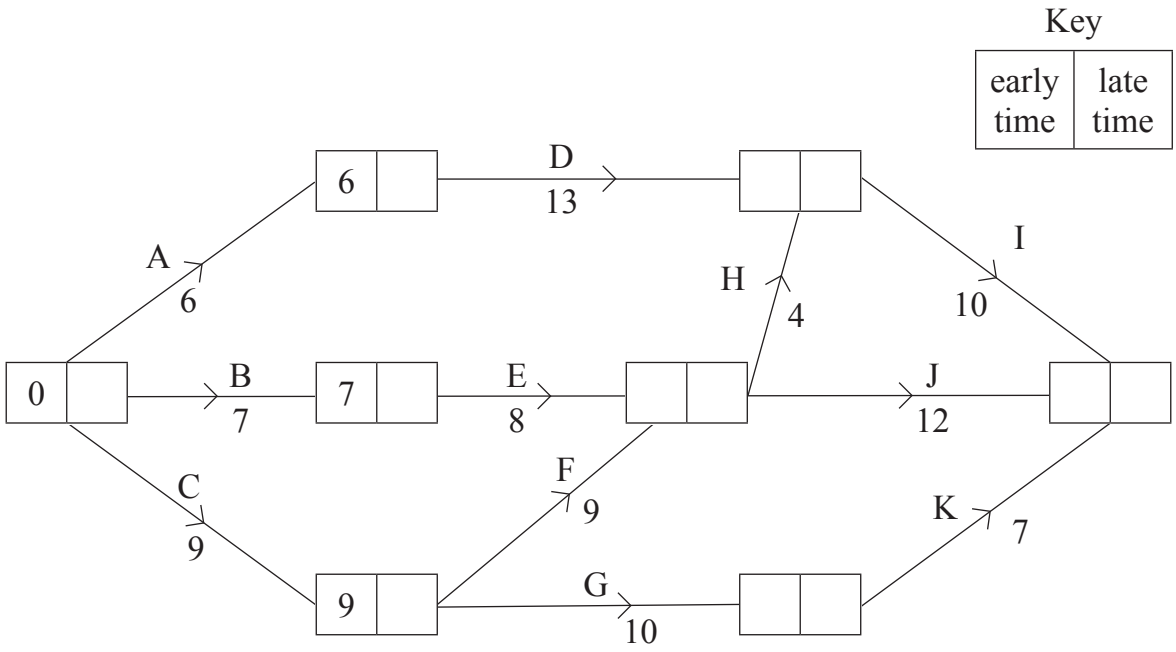
(Questions continue overleaf)

6 The diagram below shows the activity network used to model a school improvement project. The activities involved are labelled A, B, C, D, E, F, G, H, I, J, K and are represented by the edges. Each activity requires one staff member.

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



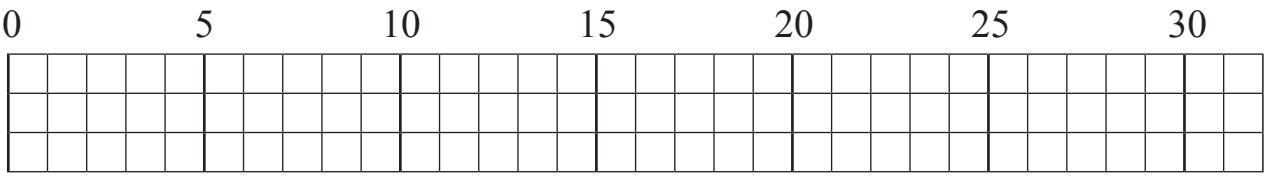
(i) Complete the diagram above by filling in the missing early times and late times. [4]

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

Answer Critical activities _____ [1]

Length of critical path _____ days [1]

(iii) Schedule the activities in the chart below so that the project is completed in 32 days by three staff.



[3]

[Turn over

7 **(a)** Café Create has 10 dishes in its main course menu every evening.

There are always three pasta dishes, four meat dishes and three vegetarian dishes on the menu.

The chef can cook six different pasta dishes, seven different meat dishes and five different vegetarian dishes.

How many different main course menus can Café Create offer?

Answer _____ [4]

(b) A school squidge-ball team of six pupils has to be chosen from eight females and seven males.

The team must include a male keeper and a female quarter-back, together with either three females and one male or two females and two males.

In how many different ways can this be done?

Answer _____ [5]

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For Examiner's use only	
Question Number	Marks
1	
2	
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Total Marks	

Examiner Number