Pearson Edexcel Level 3

GCE Further Mathematics

Advanced Subsidiary

Decision Mathematics 1

Specimen paper Time: 50 minutes	Paper Reference(s) **8FM0/27**

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 following algorithm determines the total number of comparisons required when Prim's algorithm is applied to a complete network on n vertices, where $n > 2$.

Step 1	Input the value of n
Step 2	Let A = 1
Step 3	Let B = n – 2
Step 4	Let C = B
Step 5	Let A = A + 1
Step 6	Let B = B – 1
Step 7	Let C = C + (A × B) + (A – 1)
Step 8	If B > 0 go to Step 5, otherwise go to Step 9
Step 9	Output C
Step 10	Stop

(a) (i) For the case when $n = 6$, complete the table in the answer book to show the results obtained at each step when the algorithm is applied.

(ii) State the final output.

(4)

$$\mathrm{f}(n) = \frac{1}{6}n^3 + kn + 1, \qquad n \in \mathbb{Z},\ n > 2\,.$$

The function f(n) gives the same output as the algorithm.

(b) Determine the value of k.

(2)

(c) By considering f(n), state what can be inferred about the efficiency of Prim's algorithm.

(1)

(Total for Question 1 is 7 marks)

2.

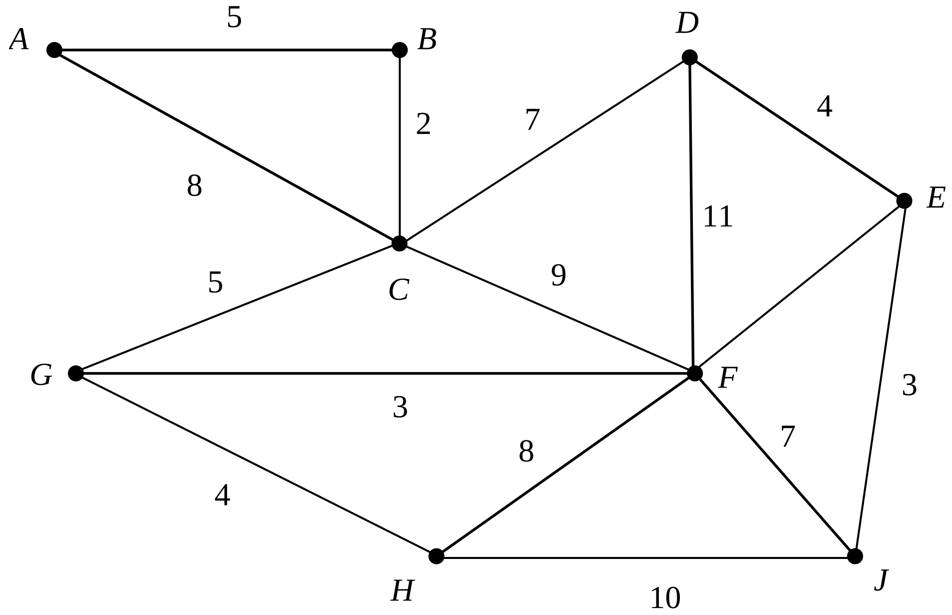

Figure 1

[*The total weight of the network is 88*]

The weights on the arcs in Figure 1 represent distances.

(a) (i) Use Dijkstra's algorithm to find the shortest path from *A* to *J*.

(ii) State the length of the shortest path from *A* to *J*.

(5)

An arc of weight 6 is added to the network between nodes *C* and *H*. An inspection route of minimum length that traverses each arc at least once needs to be found. The inspection route must start and finish at vertex *A*.

(b) Use an appropriate algorithm to find the arcs that will need to be traversed twice. You must make your method and working clear.

(4)

(c) Determine the length of the inspection route.

(1)

(Total for Question 2 is 10 marks)

3.

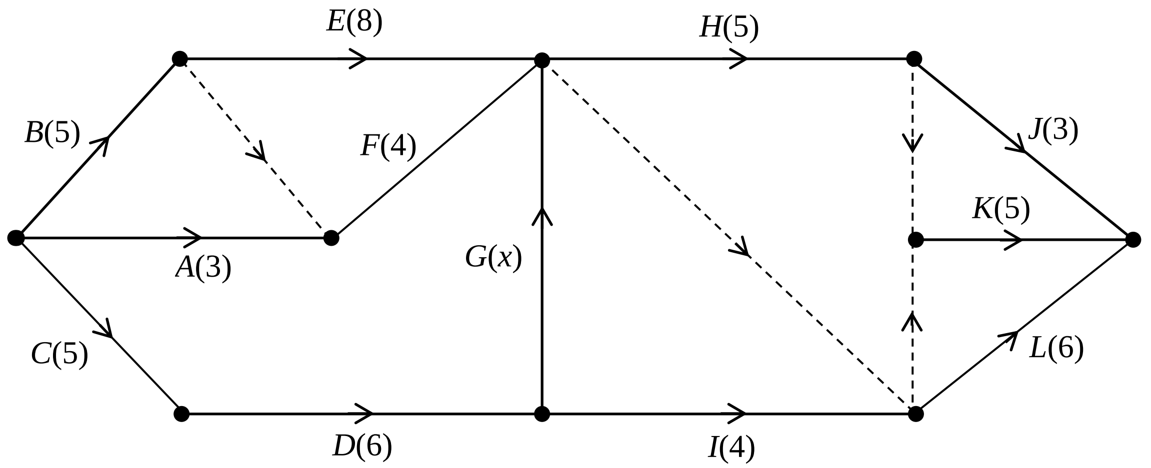

Figure 2

A project is modelled by the activity network shown in Figure 2. The activities are represented by the arcs. The number in brackets on each arc gives the time, in days, to complete the corresponding activity. Each activity requires exactly one worker. The project is to be completed in the shortest possible time.

Before the project begins, the duration of activity *G*, in days, is unknown and is given by x, where $x > 8$.

(a) Complete Diagram 1 in the answer book to show the early event times and the late event times, in terms of x where necessary.

(4)

(b) Identify the critical activities.

(1)

The sum of the total float for activity *A* and the total float for activity *E* is equal to the minimum completion time of the project.

(c) Making your reasoning clear, determine the minimum completion time for the project.

(4)

(Total for Question 3 is 9 marks)

4. A baker makes lemon cakes and cherry cakes for a forthcoming fair.

The baker must make at least 360 cakes in total.

The cost of the ingredients for each lemon cake is 40p and the cost of the ingredients for each cherry cake is 20p. The baker has a total budget of £200 to spend on ingredients.

The baker must make at least twice as many cherry cakes as lemon cakes and he must make at least 100 lemon cakes.

The baker calculates that the time required to decorate each lemon cake is 1 minute and the time required to decorate each cherry cake is 3 minutes. The baker wants to minimise the total time needed to decorate all the required cakes.

(a) Formulate this information as a linear programming problem.

(6)

(b) Use a graphical method to determine the number of each type of cake the baker should make in order to minimise the total decoration time. You should make your method and working clear.

(7)

(c) Using your solution to part (b), determine how much of the baker's budget for ingredients will be unspent.

(1)

(Total for Question 4 is 14 marks)

TOTAL FOR SECTION IS 40 MARKS

BLANK PAGE