Pearson Edexcel International Advanced Level

Decision Mathematics D1

Advanced/Advanced Subsidiary

Sample Assessment Material
Time: 1 hour 30 minutes

Paper Reference
WDM01/01

You must have:
D1 Answer Book

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. 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). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** on 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 D1 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.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.
- Do not return the question paper with the answer book.

Information

- The total mark for this paper is 75.
- 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 ▶

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Write your answers in the D1 answer book for this paper.

1.

Hajra (H)	Vicky (V)	Leisham (L)	Alice (A)	Nicky (N)	June (J)	Sharon (S)	Tom (T)	Paul (P)

The table shows the names of nine people.

(a) Use a quick sort to produce the list of names in ascending alphabetical order.

You must make your pivots clear.

(4)

(b) Use the binary search algorithm on your list to locate the name Paul.

(4)

(Total 8 marks)

2.

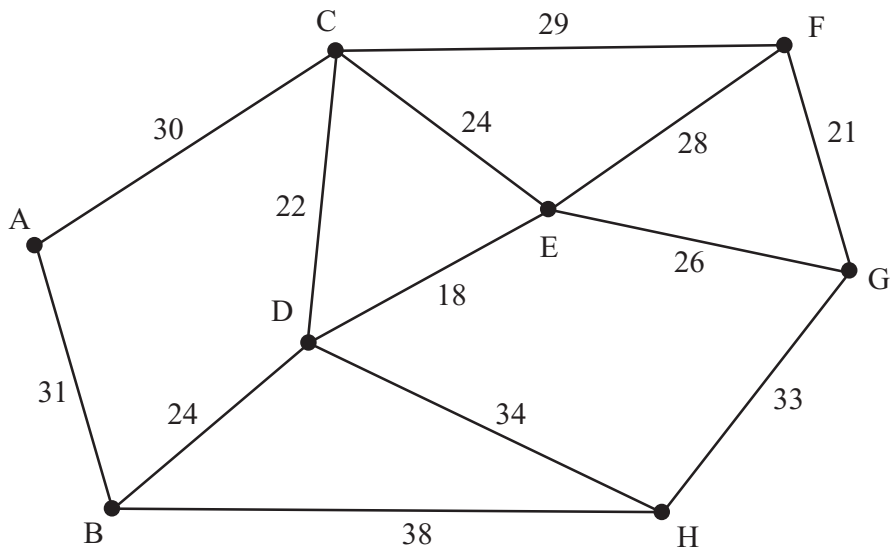

Figure 1

Figure 1 represents the distances, in metres, between eight vertices, A, B, C, D, E, F, G and H, in a network.

(a) Use Kruskal's algorithm to find a minimum spanning tree for the network.
You should list the arcs in the order in which you consider them. In each case, state whether you are adding the arc to your minimum spanning tree.

(3)

(b) Complete Matrix 1 in your answer book, to represent the network.

(2)

(c) **Starting at A, use Prim's algorithm** to determine a minimum spanning tree. You must clearly state the order in which you considered the vertices and the order in which you included the arcs.

(3)

(d) State the weight of the minimum spanning tree.

(1)

(Total 9 marks)

3.

41 28 42 31 36 32 29

The numbers in the list represent the weights, in kilograms, of seven statues. They are to be transported in crates that will each hold a maximum weight of 60 kilograms.

(a) Calculate a lower bound for the number of crates that will be needed to transport the statues.

(2)

(b) Use the first-fit bin packing algorithm to allocate the statues to the crates.

(3)

(c) Use the full bin algorithm to allocate the statues to the crates.

(2)

(d) Explain why it is not possible to transport the statues using fewer crates than the number needed for part (c).

(2)

(Total 9 marks)

4.

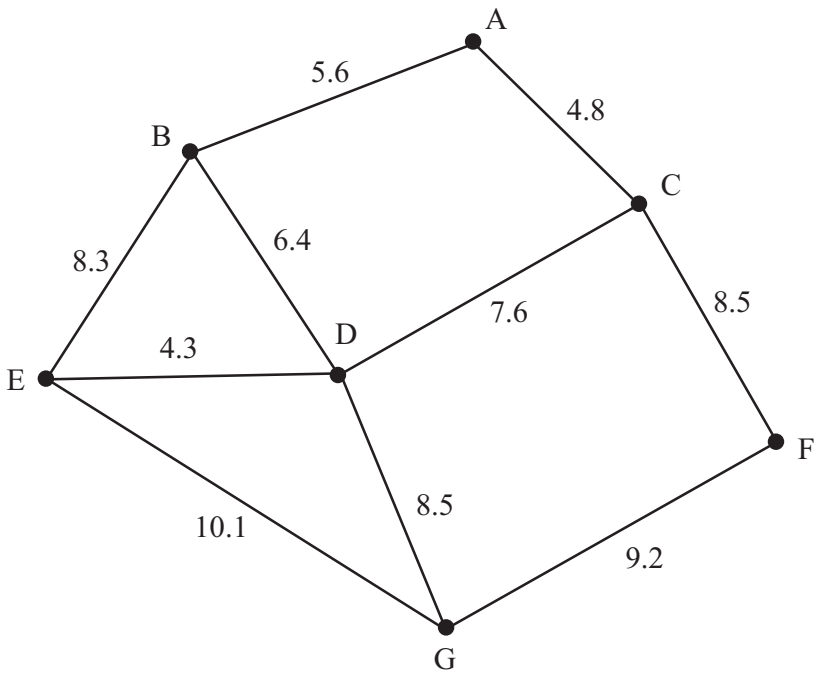

Figure 2

[*The total weight of the network is 73.3 km*]

Figure 2 models a network of tunnels that have to be inspected. The number on each arc represents the length, in km, of that tunnel.
Malcolm needs to travel through each tunnel at least once and wishes to minimise the length of his inspection route.
He must start and finish at A.

(a) Use the route inspection algorithm to find the tunnels that will need to be traversed twice. You should make your method and working clear.

(5)

(b) Find a route of minimum length, starting and finishing at A.
State the length of your route.

(3)

A new tunnel, CG, is under construction. It will be 10 km long.
Malcolm will have to include the new tunnel in his inspection route.

(c) What effect will the new tunnel have on the total length of his route?
Justify your answer.

(2)

(Total 10 marks)

5.

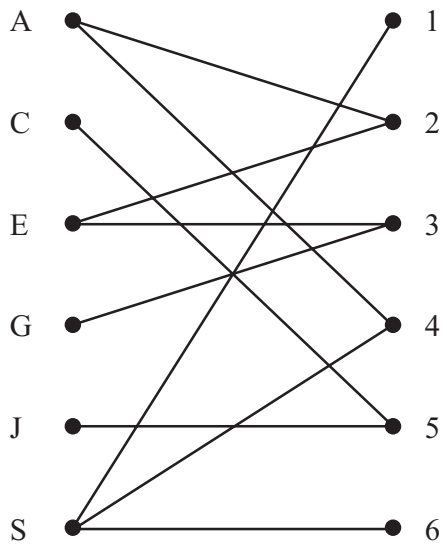

Figure 3

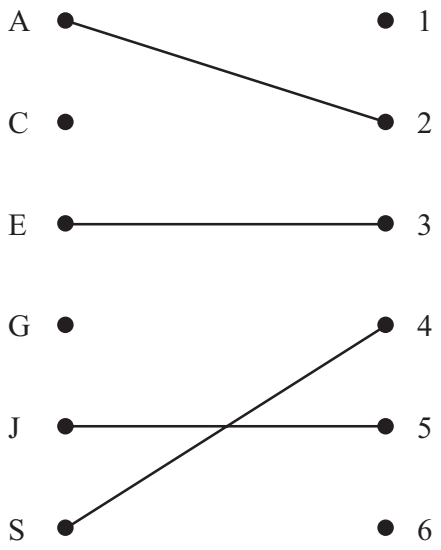

Figure 4

Figure 3 shows the possible allocations of six people, Amelia, Charlie, Ellie, Gemma, Jimmy and Saskia, to six tasks, 1, 2, 3, 4, 5 and 6.
Figure 4 shows an initial matching.

(a) Use the maximum matching algorithm once to find an improved matching.
You must state the alternating path used and your improved matching.

(3)

(b) Explain why a complete matching is not possible.

(2)

After training, Jimmy can be assigned to tasks 4 or 5 and Ellie to tasks 2, 3, 5 or 6.

(c) **Starting with your current maximal matching**, use the maximum matching algorithm to obtain a complete matching. You must state the alternating path used and your final matching.

(3)

(Total 8 marks)

6.

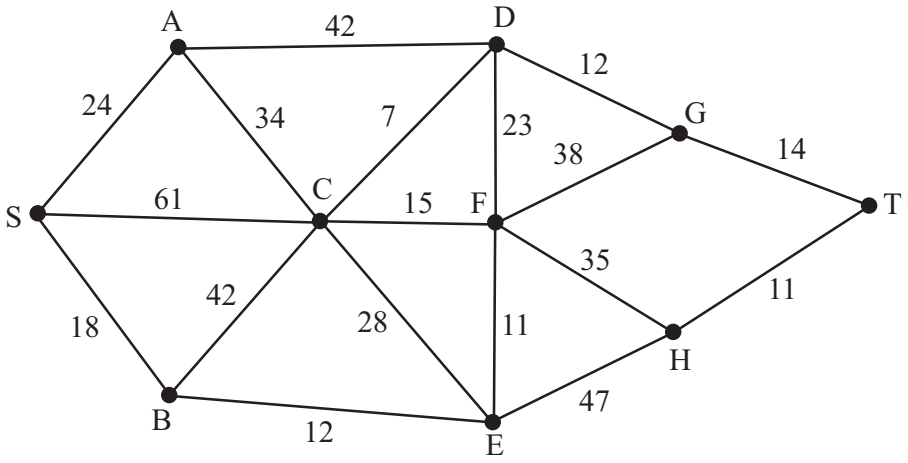

Figure 5

Figure 5 shows a network of cycle tracks within a national park. The number on each arc represents the time taken, in minutes, to cycle along the corresponding track.

(a) Use Dijkstra's algorithm to find the quickest route from S to T. State your quickest route and the time it takes.

(6)

(b) Explain how you determined your quickest route from your labelled diagram.

(2)

(c) Write down the quickest route from E to T.

(1)

(Total 9 marks)

7.

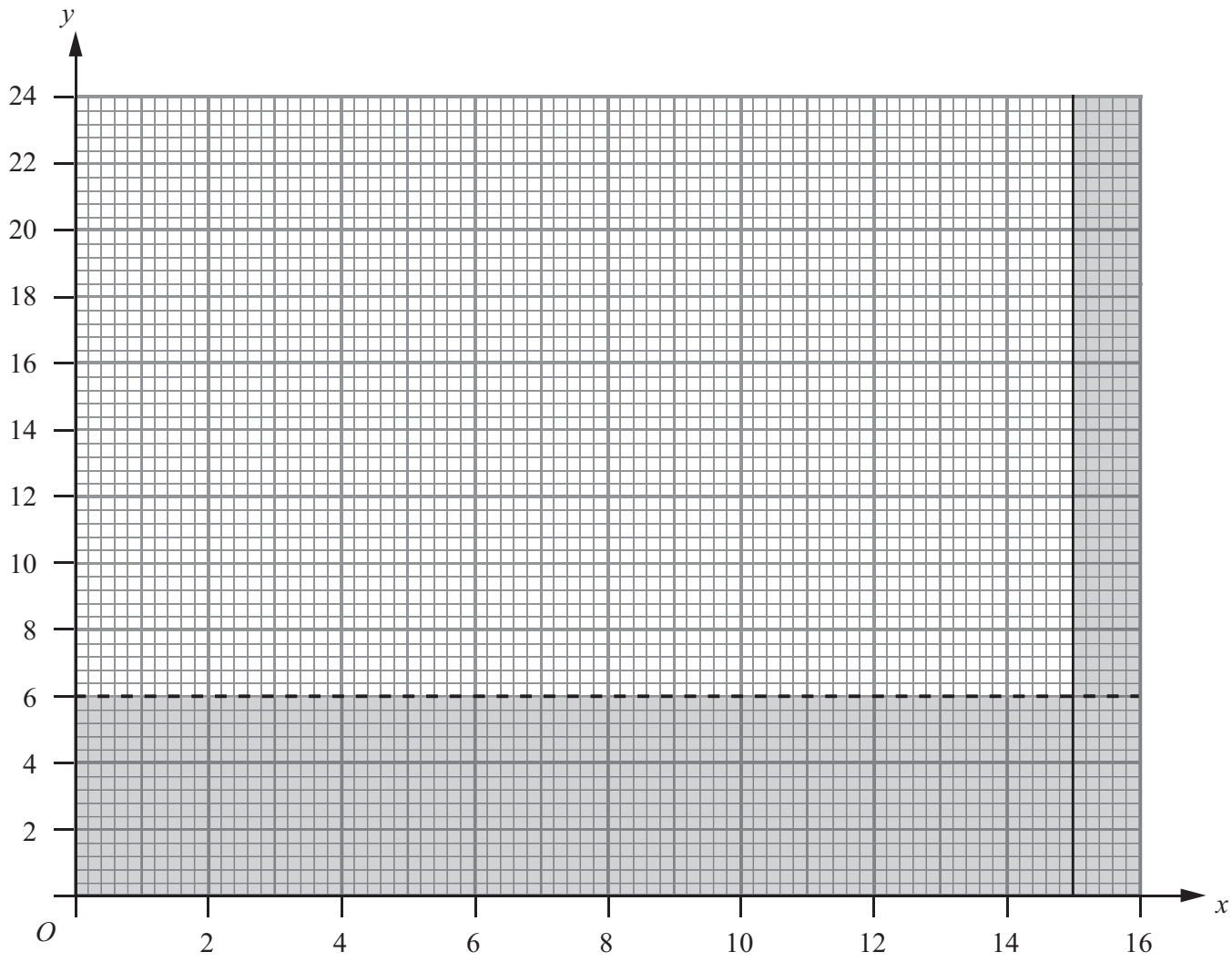

Figure 6

Keith organises two types of children's activity, 'Sports Mad' and 'Circus Fun'.
He needs to determine the number of times each type of activity is to be offered.

Let x be the number of times he offers the 'Sports Mad' activity. Let y be the number of times he offers the 'Circus Fun' activity.

Two constraints are

$$x \leqslant 15$$
$$\text{and} \quad y > 6$$

These constraints are shown on the graph in Figure 6, where the rejected regions are shaded out.

(a) Explain why $y = 6$ is shown as a dotted line.

(1)

Two further constraints are

$$3x \geqslant 2y$$
$$\text{and} \quad 5x + 4y \geqslant 80$$

(b) Add two lines and shading to Diagram 1 in the answer book to represent these inequalities. Hence determine the feasible region and label it R.

(3)

Each 'Sports Mad' activity costs £500.
Each 'Circus Fun' activity costs £800.

Keith wishes to minimise the total cost.

(c) Write down the objective function, C, in terms of x and y.

(2)

(d) Use your graph to determine the number of times each type of activity should be offered and the total cost. You must show sufficient working to make your method clear.

(5)

(Total 11 marks)

8.

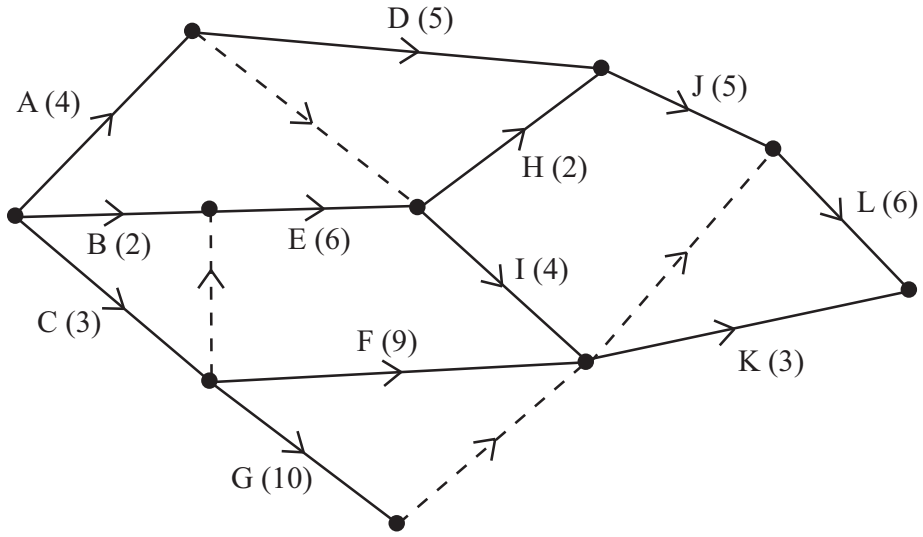

Figure 7

A project is modelled by the activity network shown in Figure 7. The activities are represented by the arcs. The number in brackets on each arc gives the time, in days, to complete the activity. Each activity requires one worker. The project is to be completed in the shortest possible time.

(a) Complete Diagram 2 in the answer book to show the early and late event times.

(4)

(b) State the critical activities.

(1)

(c) On Grid 1 in the answer book, draw a cascade (Gantt) chart for this project.

(4)

(d) Use your cascade chart to determine a lower bound for the number of workers needed. You must justify your answer.

(2)

(Total 11 marks)

TOTAL FOR PAPER: 75 MARKS

END