Paper Reference(s)

6689/01

Edexcel GCE

Decision Mathematics D1

Advanced/Advanced Subsidiary

Friday 20 January 2012 – Afternoon

Time: 1 hour 30 minutes

Materials required for examination
Nil

Items included with question papers
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 or symbolic differentiation/integration, or have retrievable mathematical formulae stored in them.

Instructions to Candidates

Write your answers for this paper in the D1 answer book provided.
In the boxes on the answer book, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
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 for Candidates

Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 7 questions in this question paper. The total mark for this paper is 75.
There are 12 pages in this question paper. The answer book has 20 pages. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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

1.

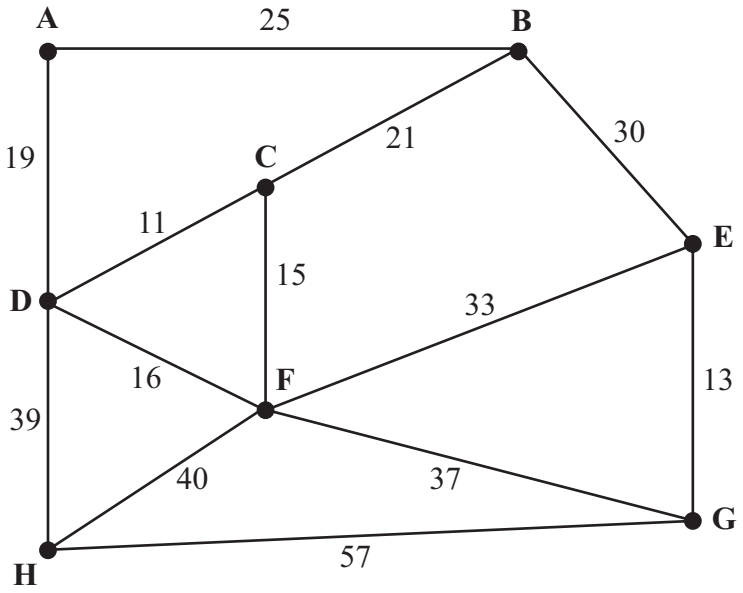


Figure 1

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

(a) Use **Kruskal's** algorithm to find the 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) Starting at A, use **Prim's** algorithm to find the minimum spanning tree. You must clearly state the order in which you selected the arcs of your tree.

(3)

(c) Draw the minimum spanning tree using the vertices given in Diagram 1 in the answer book.

(1)

(d) State the weight of the tree.

(1)

(Total 8 marks)

2.

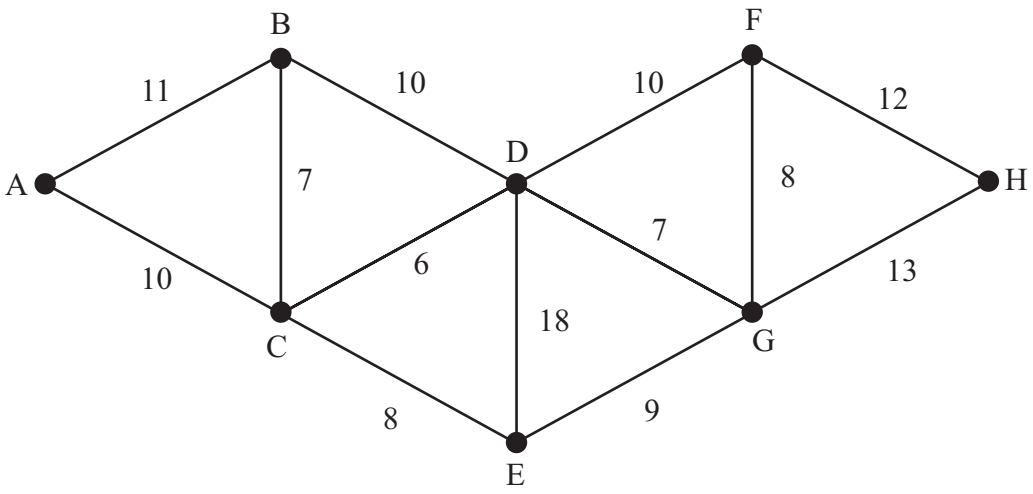


Figure 2

[The weight of the network is 129 miles]

Figure 2 models a network of canals. The number on each arc gives the length, in miles, of that canal.

Brett needs to travel along each canal to check that it is in good repair. He wishes to minimise the length of his route.

(a) Use the route inspection algorithm to find the length of his route. State the arcs that should be repeated. You should make your method and working clear.

(6)

A canal between B and F, of length 12 miles, is to be opened and needs to be included in Brett's inspection route.

(b) Determine if the addition of this canal will increase or decrease the length of Brett's minimum route. You must make your reasoning clear.

(2)

(Total 8 marks)

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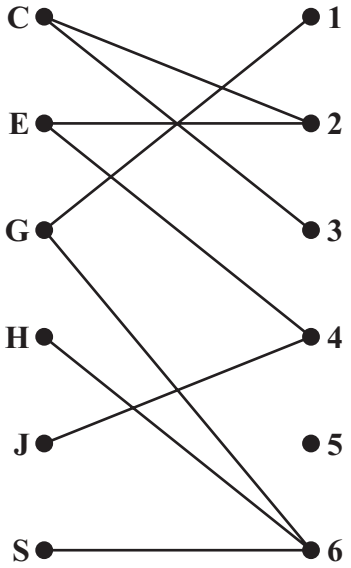


Figure 3

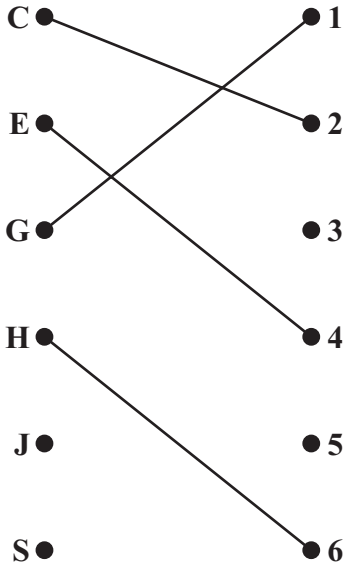


Figure 4

Define the terms

(a) bipartite graph,

(2)

(b) matching.

(2)

Figure 3 shows the possible allocations of six people, Charles (C), Emily (E), George (G), Harriet (H), Jack (J) and Shen (S), to six tasks, 1, 2, 3, 4, 5 and 6.

Figure 4 shows an initial matching.

(c) Starting from this initial matching, use the maximum matching algorithm to find an improved matching. You should list the alternating path you use and state your improved matching.

(3)

Emily has task 5 added to her possible allocations and Harriet has task 3 added to her possible allocations.

(d) Starting from the improved matching found in part (c), use the maximum matching algorithm to find a complete matching. You should list the alternating path you use and state your improved matching.

(3)

(Total 10 marks)

4.

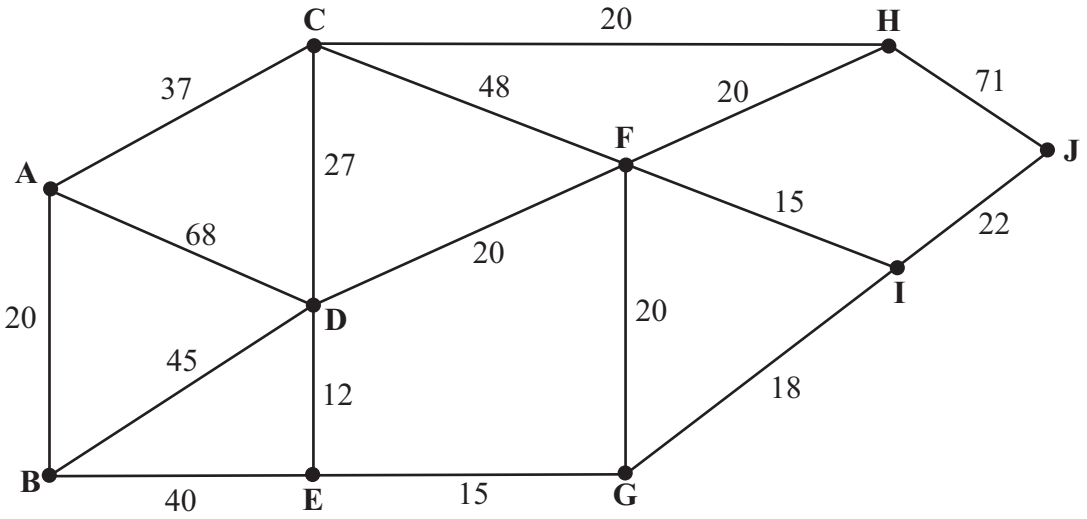


Figure 5

Figure 5 models a network of roads. The number on each edge gives the time, in minutes, taken to travel along that road. Olivia wishes to travel from A to J as quickly as possible.

(a) Use Dijkstra's algorithm to find the shortest time needed to travel from A to J. State the shortest route.

(7)

On a particular day Olivia must include G in her route.

(b) Find a route of minimal time from A to J that includes G, and state its length

(2)

(Total 9 marks)

5.

5 1 8 13 16 5 8 2 15 12 10

(a) Use the first-fit bin packing algorithm to determine how the numbers listed above can be packed into bins of size 20.

(3)

(b) The list of numbers is to be sorted into **descending** order. Use a bubble sort to obtain the sorted list, giving the state of the list after each **complete** pass.

(5)

(c) Apply the first-fit decreasing bin packing algorithm to your ordered list to pack the numbers into bins of size 20.

(3)

(d) Determine whether your answer to (c) uses the minimum number of bins. You must justify your answer.

(2)

(Total 13 marks)

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6.

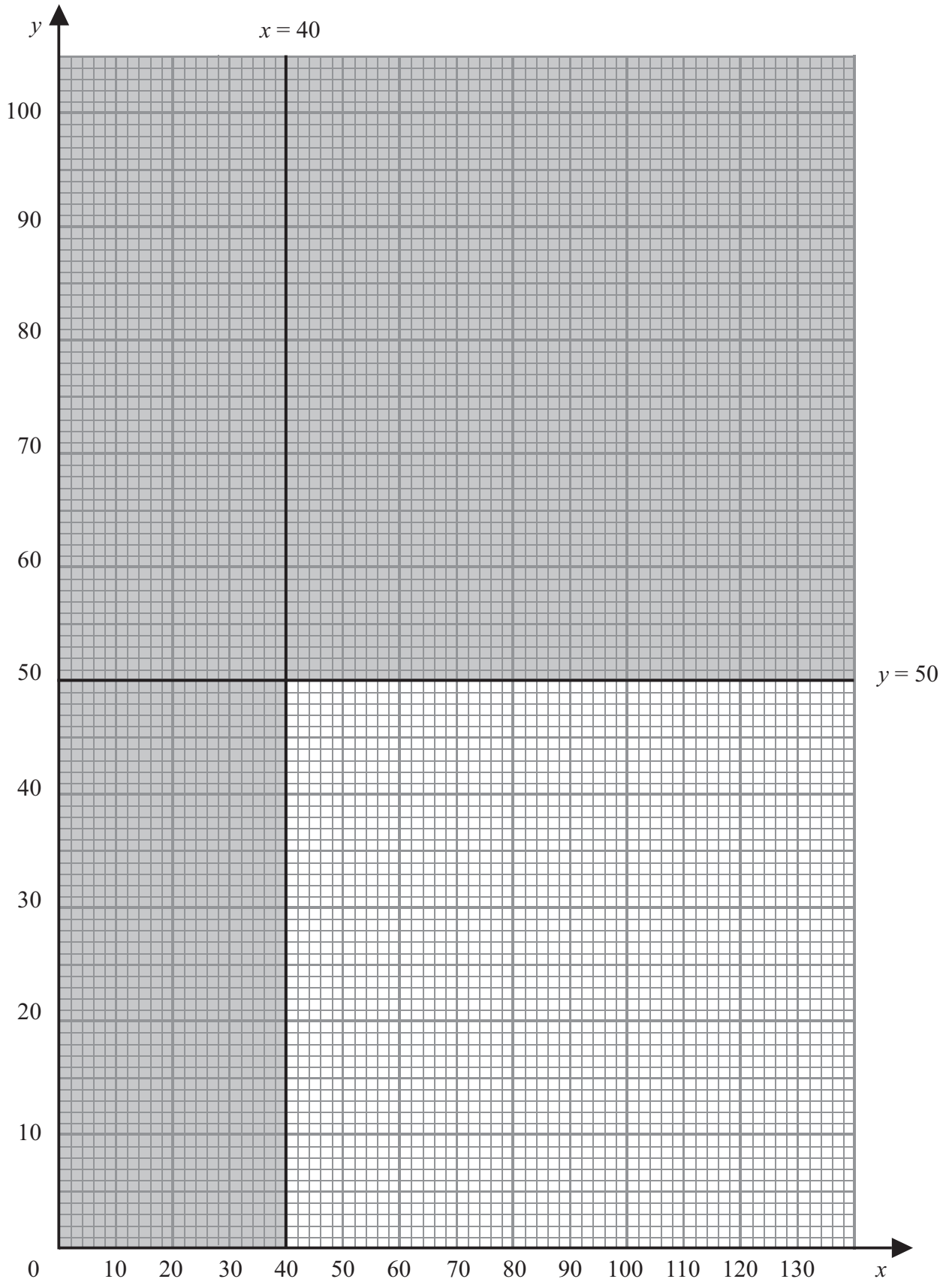

y
x = 40
100
90
80
70
60
50
y = 50
40
30
20
10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
x

Figure 6

Edgar has recently bought a field in which he intends to plant apple trees and plum trees.

He can use linear programming to determine the number of each type of tree he should plant.

Let x be the number of apple trees he plants and y be the number of plum trees he plants.

Two of the constraints are

$$x \geqslant 40$$

$$y \leqslant 50$$

These are shown on the graph in Figure 6, where the rejected region is shaded out.

(a) Use these two constraints to write down two statements that describe the number of apple trees and plum trees Edgar can plant.

(1)

Two further constraints are

$$3x + 4y \leqslant 360$$

$$x \leqslant 2y$$

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

(4)

Edgar will make a profit of £60 from each apple tree and £20 from each plum tree. He wishes to maximise his profit, P.

(c) Write down the objective function.

(1)

(d) Use an objective line to determine the optimal point of the feasible region, R. You must make your method clear.

(4)

(e) Find Edgar's maximum profit.

(1)

(Total 11 marks)

7.

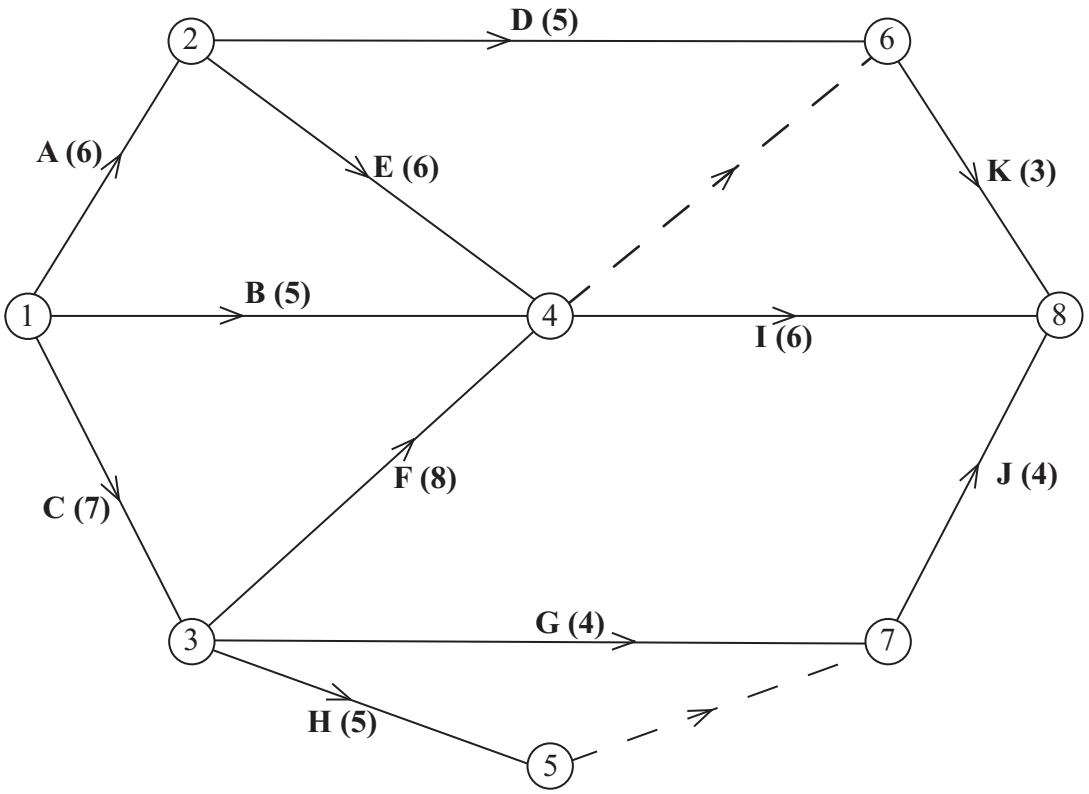


Figure 7

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 required, in hours, to complete the activity. The numbers in circles are the event numbers. Each activity requires one worker.

(a) Explain the significance of the dummy activity
(i) from event 4 to event 6,
(ii) from event 5 to event 7

(3)

(b) Calculate the early time and the late time for each event. Write these in the boxes in the answer book.

(4)

(c) Calculate the total float on each of activities D and G. You must make the numbers you use in your calculations clear.

(3)

(d) Calculate a lower bound for the minimum number of workers required to complete the project in the minimum time.

(2)

(e) On the grid in your answer book, draw a cascade (Gantt) chart for this project.

(4)

(Total 16 marks)

TOTAL FOR PAPER: 75 MARKS

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Candidate No.						6	6	8	9	/	0	1	Signature	

Paper Reference(s)

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Edexcel GCE

Decision Mathematics D1

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Answer Book

Do not return the question paper with the answer book

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
Total	

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1.

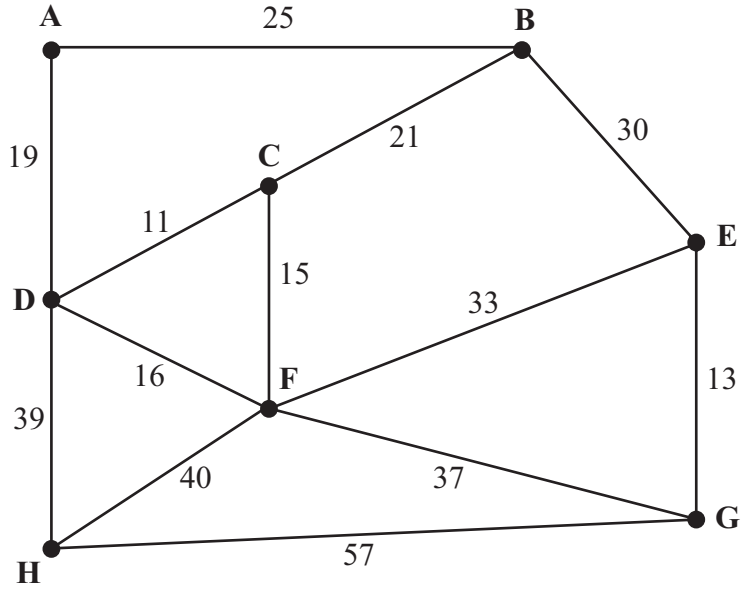


Figure 1

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Question 1 continued

(c)

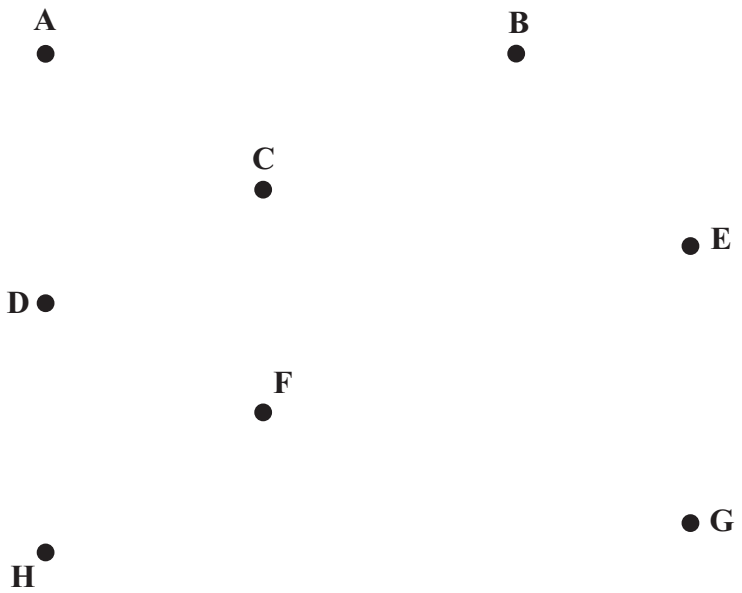


Diagram 1

(d) Weight of tree = ...

Q1

(Total 8 marks)

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2.

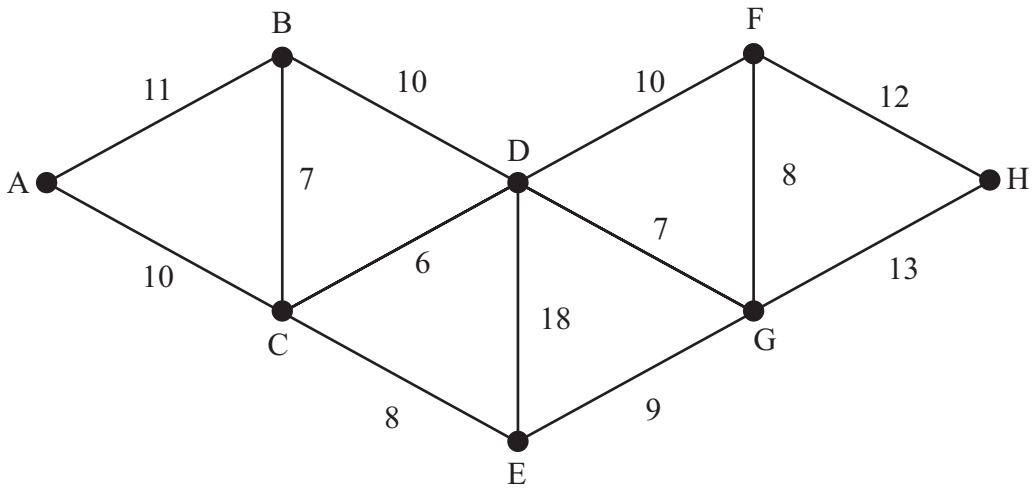


Figure 2

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Question 2 continued

Q2

(Total 8 marks)

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3.

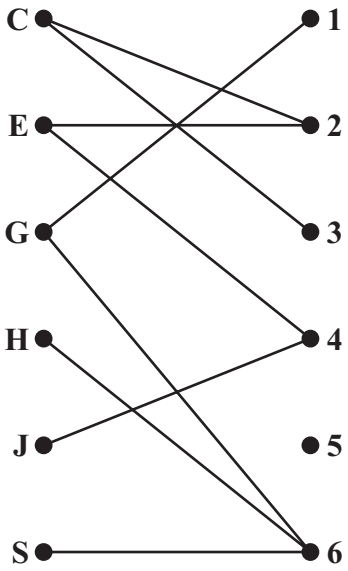


Figure 3

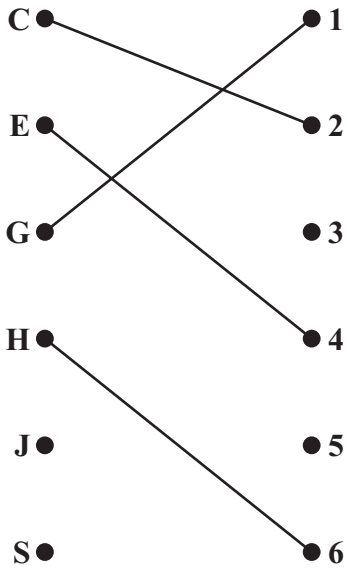


Figure 4

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Question 3 continued

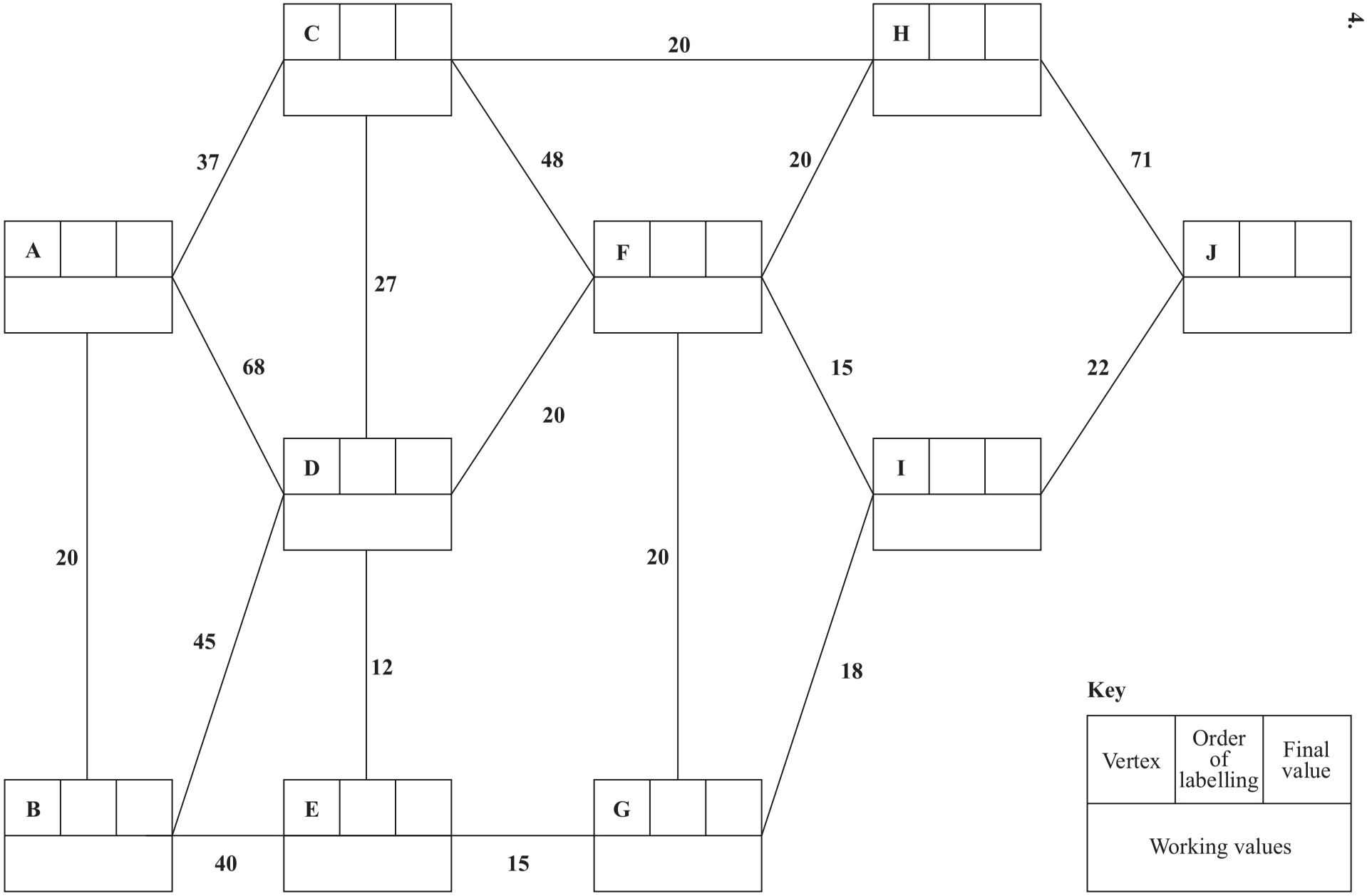
C ●	● 1	C ●	● 1
E ●	● 2	E ●	● 2
G ●	● 3	G ●	● 3
H ●	● 4	H ●	● 4
J ●	● 5	J ●	● 5
S ●	● 6	S ●	● 6

(Total 10 marks)

Q3

P 3 8 2 4 5 A 0 8 2 0

4.



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Question 4 continued

Q4

(Total 9 marks)

Leave blank

5.

5 1 8 13 16 5 8 2 15 12 10

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Question 5 continued

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Question 5 continued

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Question 5 continued

Q5

(Total 13 marks)

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6.

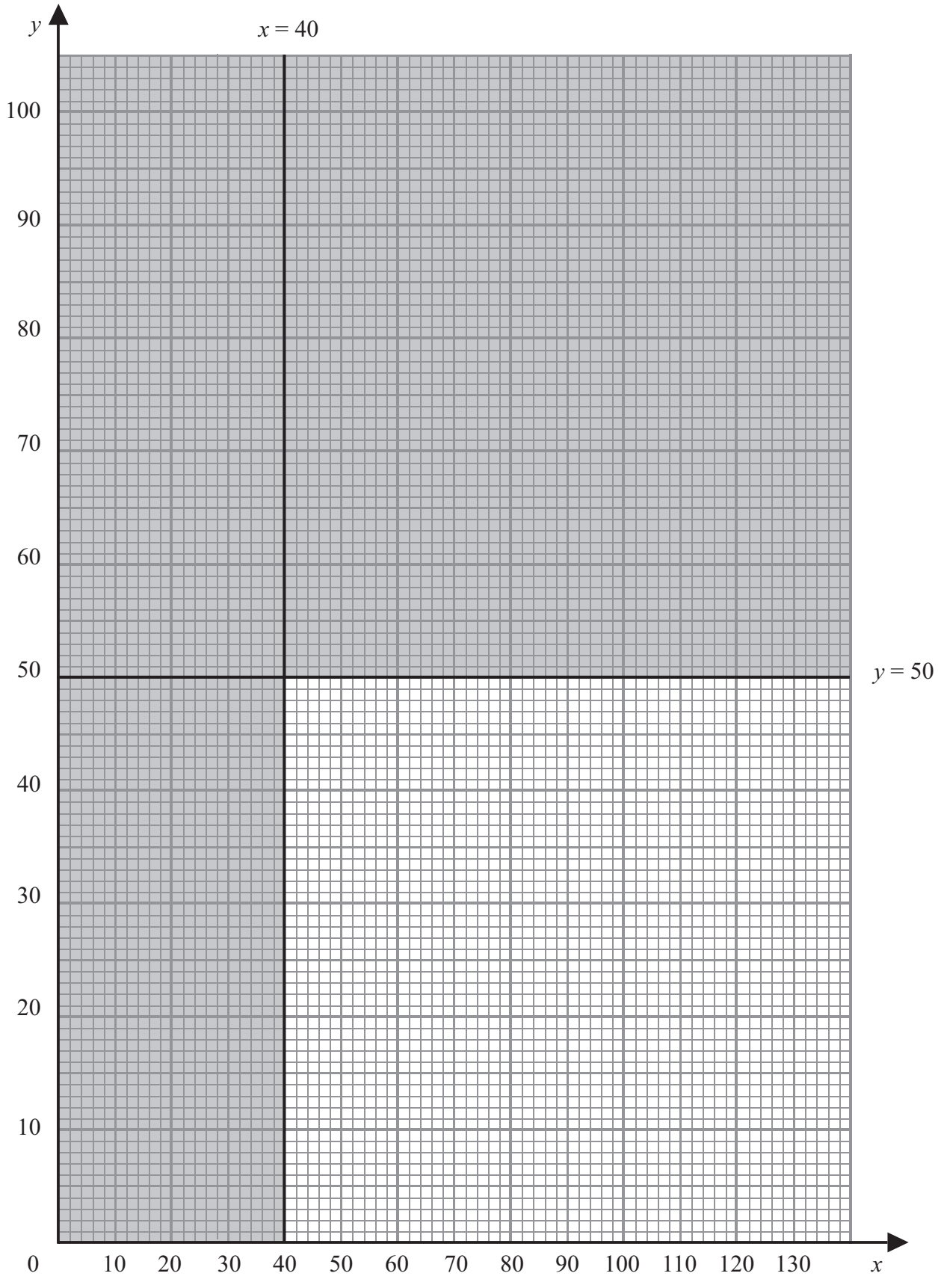


Diagram 1

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Question 6 continued

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Question 6 continued

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Question 6 continued

Q6

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7. (a) (i) _____

_____

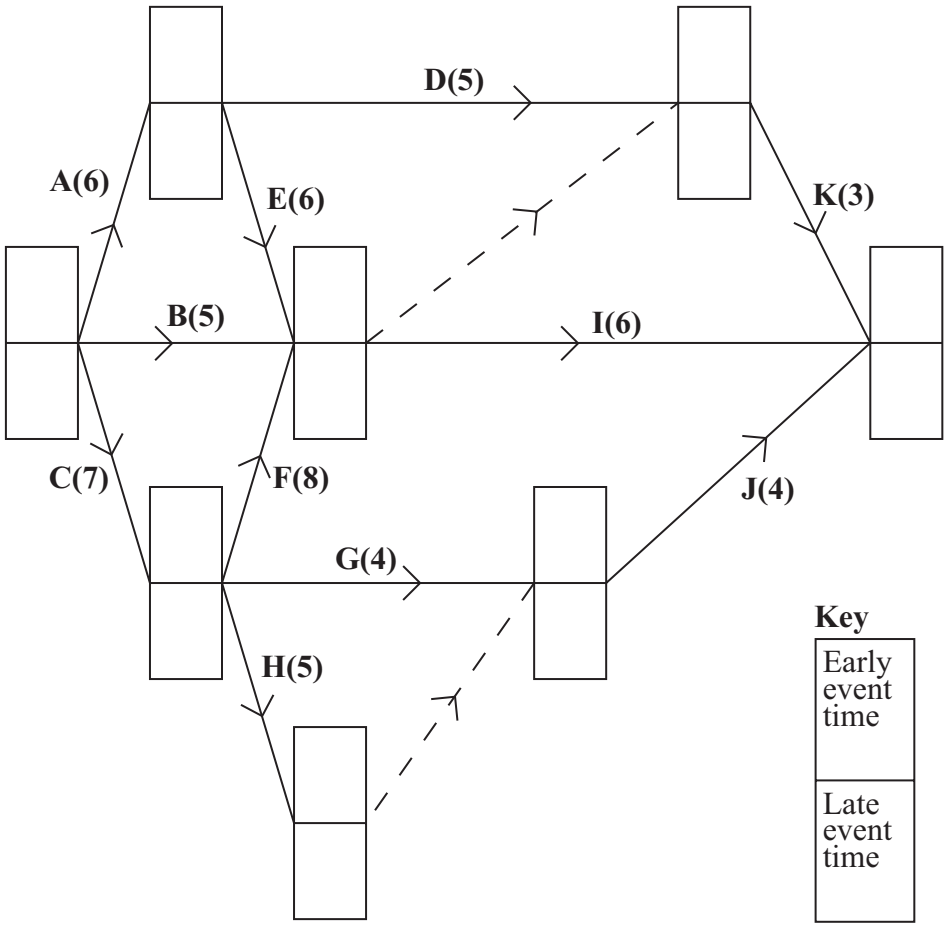
_____

(ii) _____

_____

_____

(b)



(c) _____

_____

_____

_____

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Question 7 continued

(d) _____

_____

_____

_____



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Question 7 continued

Q7

(Total 16 marks)

TOTAL FOR PAPER: 75 MARKS

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