Paper Reference(s)

6689/01

Edexcel GCE

Decision Mathematics D1

Advanced/Advanced Subsidiary

Wednesday 19 January 2011 – 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, differentiation and 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 8 pages in this question paper. The answer book has 16 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.

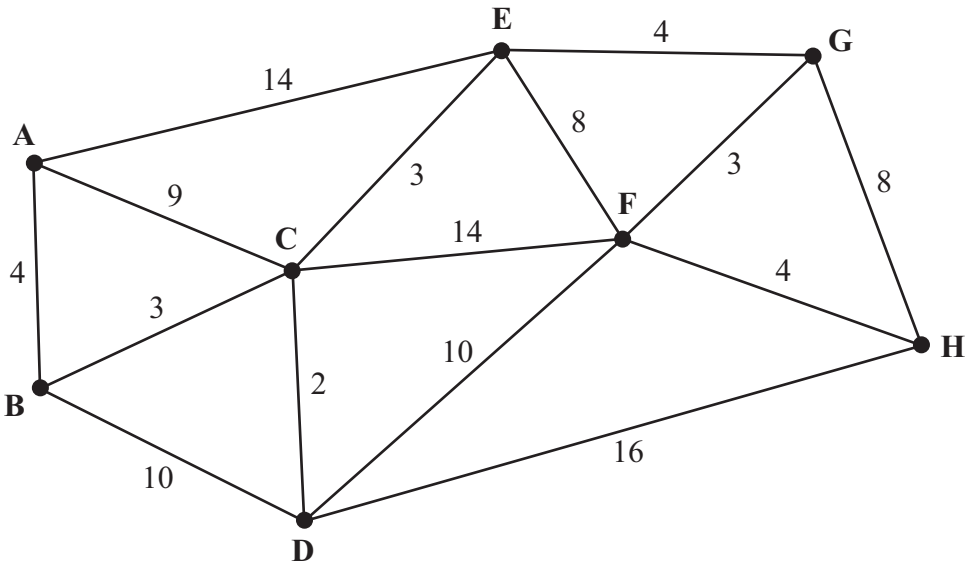


Figure 1

Figure 1 shows a network of roads between eight villages, A, B, C, D, E, F, G and H. The number on each arc gives the length, in miles, of the corresponding road.

(a) Use Dijkstra's algorithm to find the shortest distance from A to H.

(5)

(b) State your shortest route.

(1)

(c) Write down the shortest route from H to C and state its length.

(2)

(Total 8 marks)

2.

23 29 11 34 10 14 35 17

The numbers represent the sizes, in megabytes (MB), of eight files.

The files are to be stored on 50 MB discs.

(a) Calculate a lower bound for the number of discs needed to store all eight files.

(2)

(b) Use the first-fit bin packing algorithm to fit the files onto the discs.

(3)

(c) Perform a bubble sort on the numbers in the list to sort them into descending order. You need only write down the final result of each pass.

(4)

(d) Use the first-fit decreasing bin packing algorithm to fit the files onto the discs.

(3)

(Total 12 marks)

3.

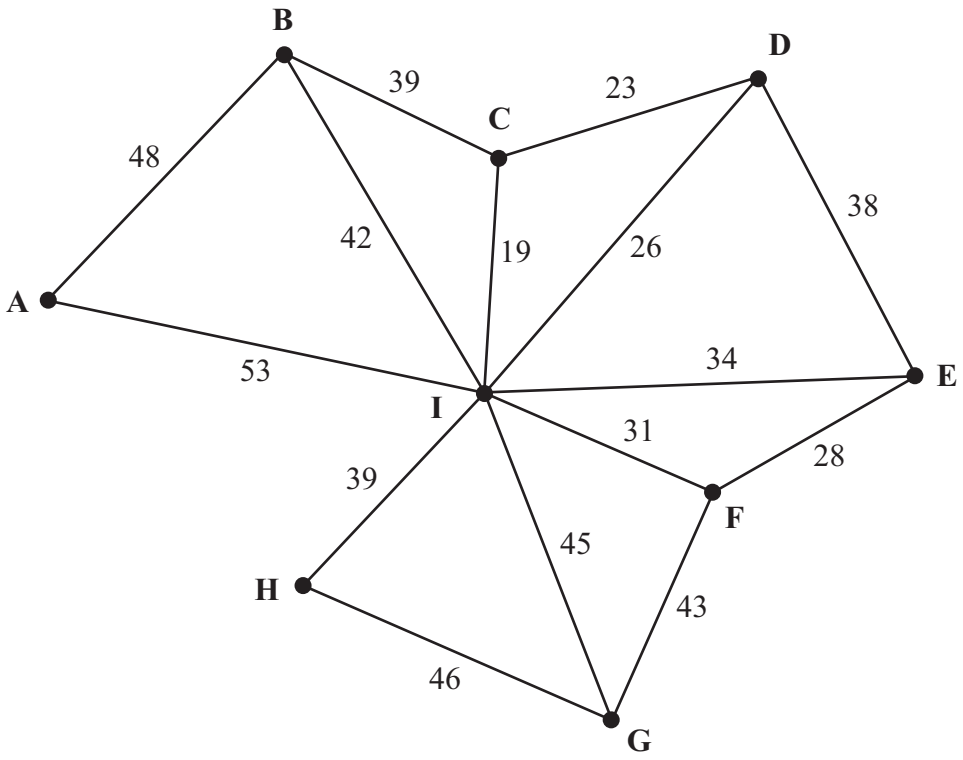


Figure 2

(a) Use Kruskal's algorithm to find a minimum spanning tree for the network shown in Figure 2. 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 a minimum spanning tree for the network in Figure 2. You must clearly state the order in which you include the arcs in your tree.

(3)

(c) Draw a minimum spanning tree for the network in Figure 2 using the vertices given in Diagram 1 of the answer book. State the weight of the minimum spanning tree.

(2)

A new spanning tree is required which includes the arcs DI and HG, and which has the lowest possible total weight.

(d) Explain which algorithm you would choose to complete the tree, and how the algorithm should be adapted. (You do not need to find the tree.)

(2)

(Total 10 marks)

4.

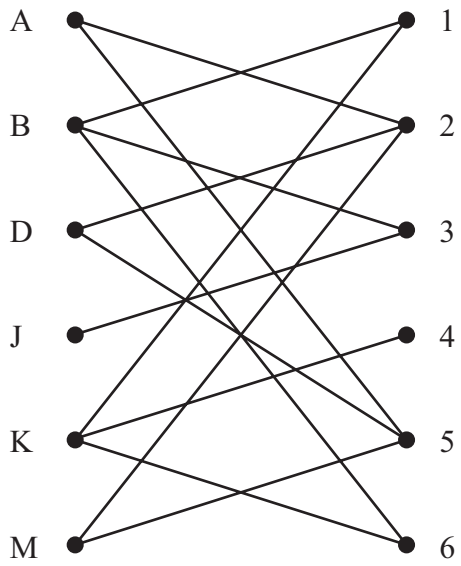


Figure 3

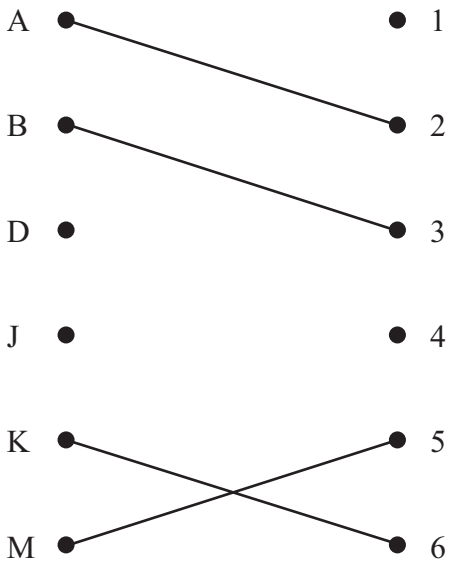


Figure 4

Six workers, Anthony, Beth, David, Jacob, Kantola and Miri, are to be allocated to six tasks, 1, 2, 3, 4, 5 and 6.

Figure 3 shows the possible allocations of the workers, and an initial matching is shown in Figure 4.

(a) Write down the technical name given to the type of diagram shown in Figure 3.

(1)

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

(3)

Anthony now agrees to add task 6 to his possible allocations.

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

(3)

(Total 7 marks)

5.

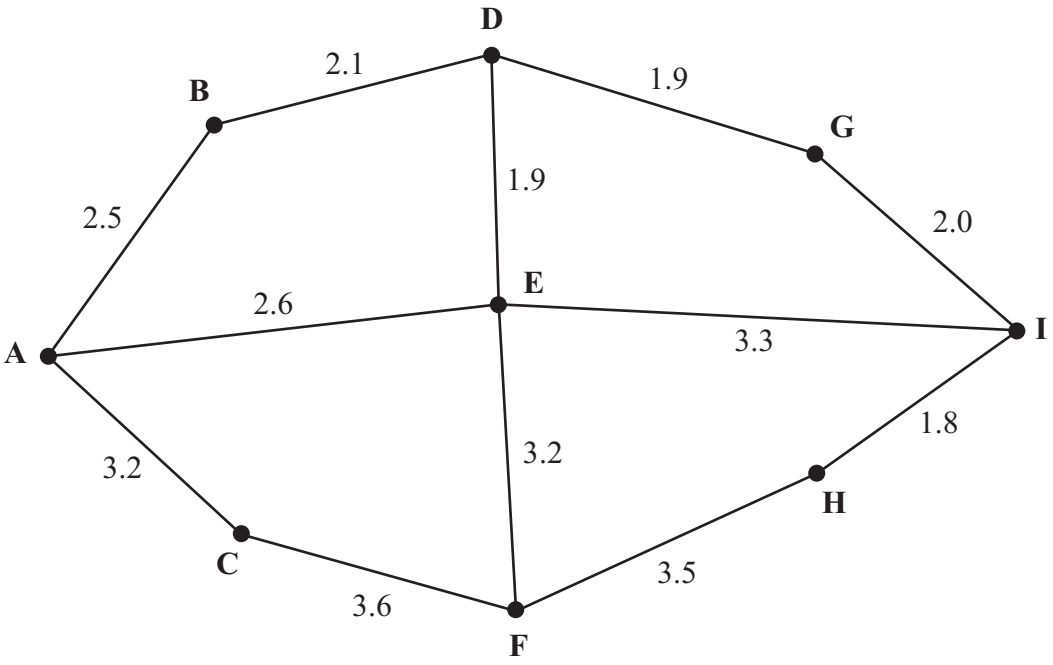


Figure 5

[The total weight of the network is 31.6 km]

Figure 5 models a network of roads. The road markings on these roads are to be renewed. The number on each arc represents the length, in km, of that road. In order to renew the road markings, each road must be traversed at least once.

(a) Use the route inspection algorithm, starting and finishing at A, to find a suitable route, which should be stated. You must make your method and working clear.

(5)

(b) State the roads that must be traversed twice and the length of the route.

(3)

The machine that will be used to renew the road markings can only be delivered to D. It will start at D, but it may finish at any vertex.
Each road must still be traversed at least once.

(c) Given that the route is to be minimised, determine where the machine should finish. Give reasons to justify your answer.

(3)

(Total 11 marks)

6.

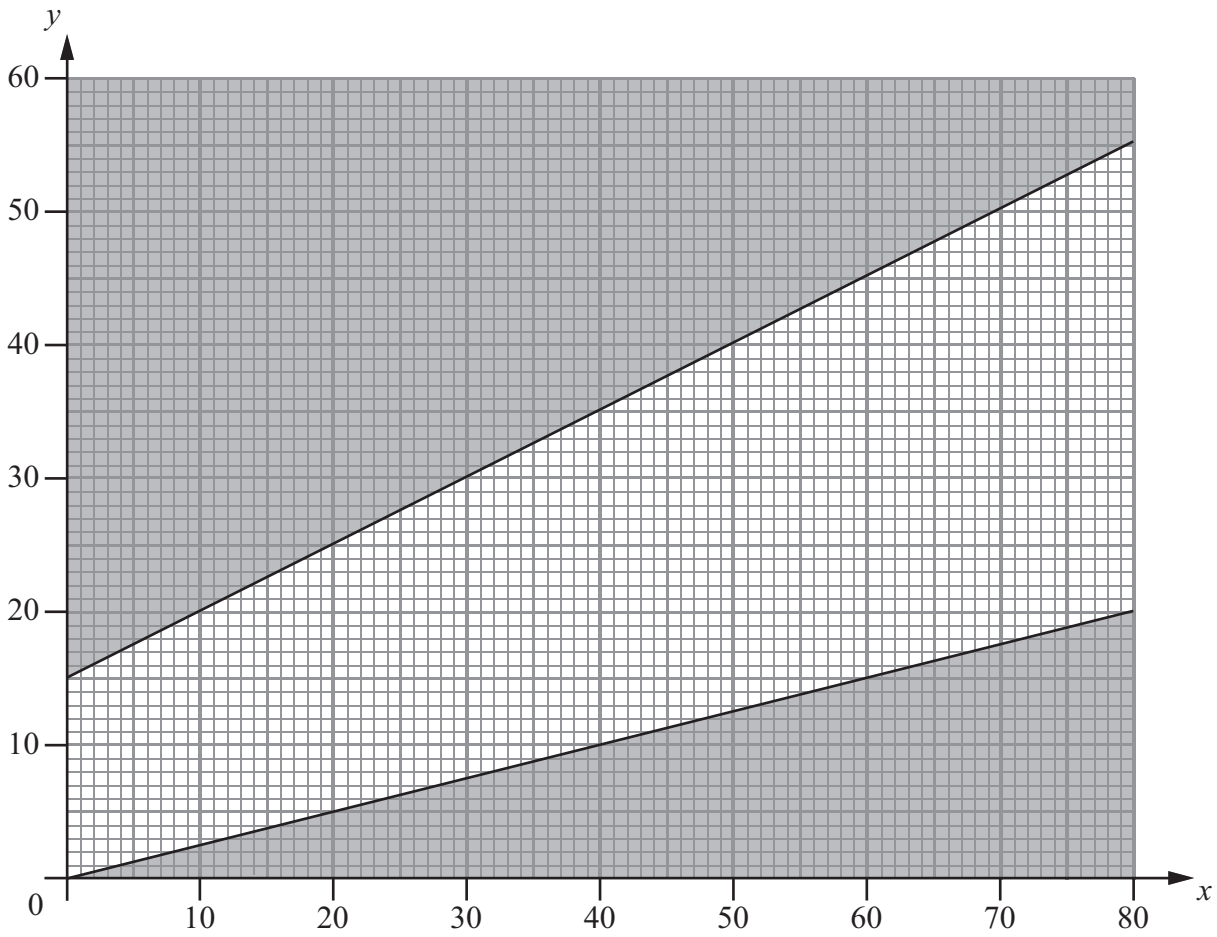


Figure 6

The graph in Figure 6 is being used to solve a linear programming problem.
Two of the constraints have been drawn on the graph and the rejected regions shaded out.

(a) Write down the constraints shown on the graph.

(4)

Two further constraints are

$$x + y \geqslant 30$$

and $$5x + 8y \leqslant 400$$

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

(4)

The objective is to

$$\text{minimise } 15x + 10y$$

(c) Draw a profit line on Graph 1 and use it to find the optimal solution. You must label your profit line clearly.

(3)

(Total 11 marks)

7.

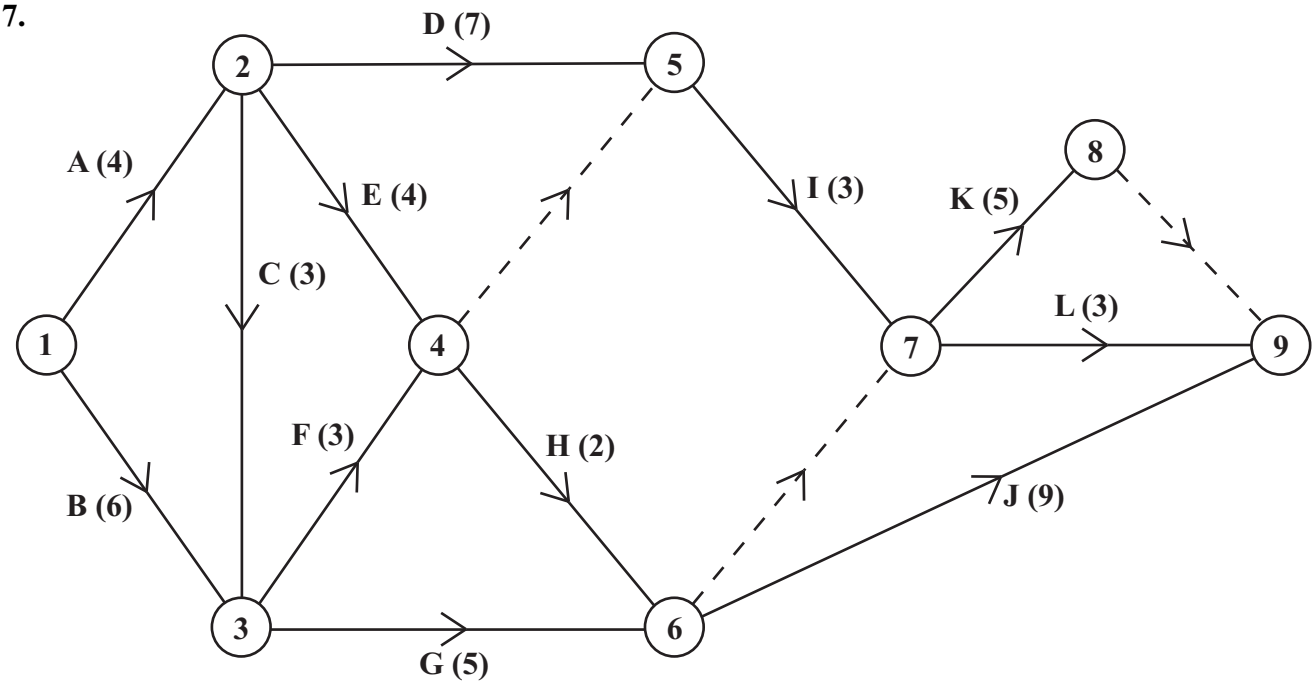


Figure 7

The network in Figure 7 shows the activities that need to be undertaken to complete a maintenance project. The activities are represented by the arcs. The number in brackets on each arc gives the time, in days, to complete the activity. The numbers in circles are the events.

Each activity requires one worker. The project is to be completed in the shortest possible time.

(a) Complete the precedence table for this network in the answer book.

(3)

(b) Explain why each of the following is necessary.

(i) The dummy from event 6 to event 7.
(ii) The dummy from event 8 to event 9.

(3)

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

(4)

(d) State the critical activities.

(2)

(e) Calculate the total float on activity K. You **must** make the numbers used in your calculation clear.

(2)

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

(2)

(Total 16 marks)

TOTAL FOR PAPER: 75 MARKS

END

Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	6	8	9	/	0	1	Signature	

Paper Reference(s)

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Edexcel GCE

Decision Mathematics D1

Advanced/Advanced Subsidiary

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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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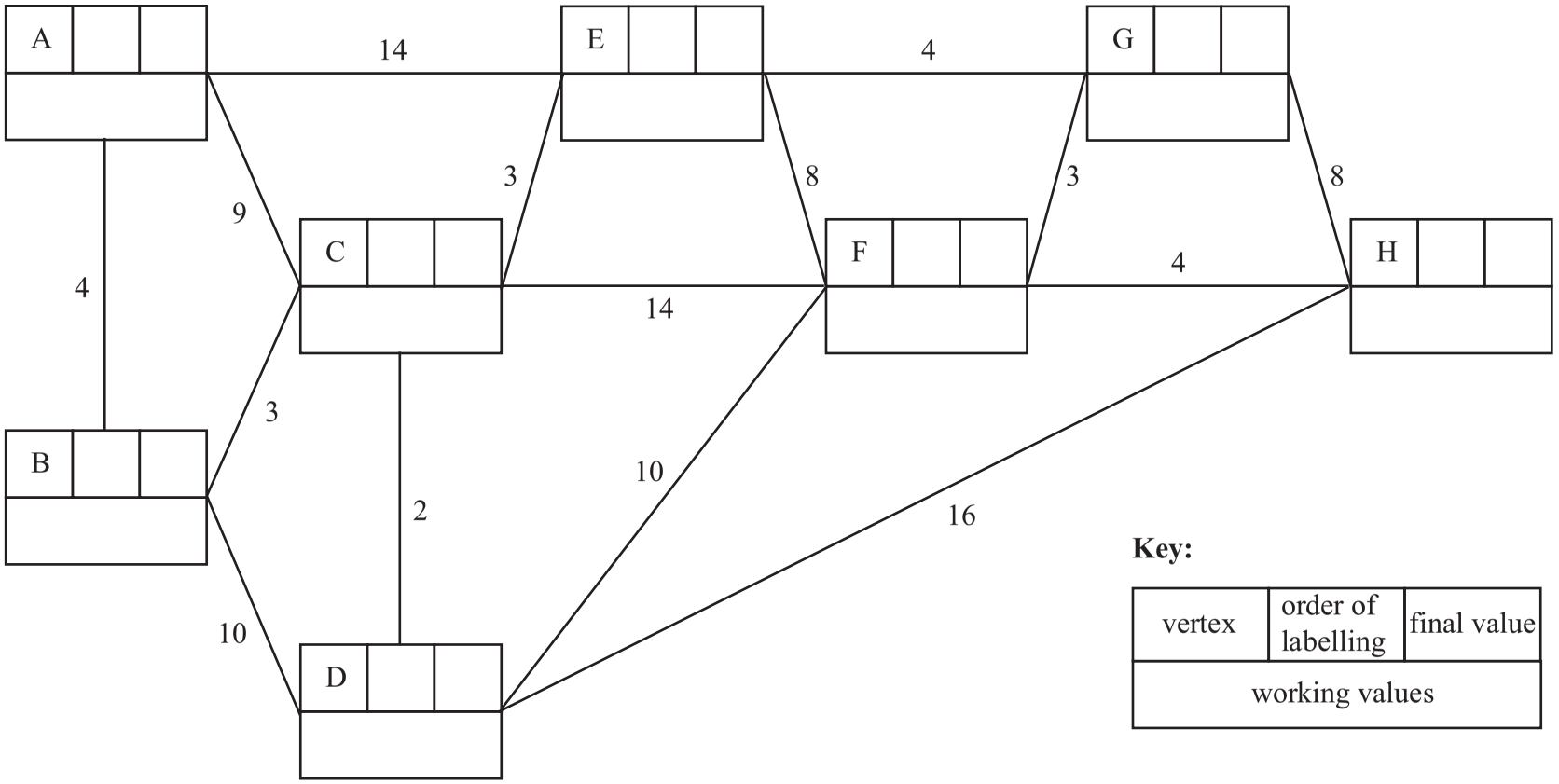
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N 3 5 4 1 2 A 0 1 1 6

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1. (a)



Key:

vertex	order of labelling	final value
working values		

Shortest distance A to H: _____

Leave blank

N 3 5 4 1 2 A 0 2 1 6

Leave blank

Question 1 continued

(b)

(c)

Q1

(Total 8 marks)

Leave blank

2.

23 29 11 34 10 14 35 17

Leave blank

Question 2 continued

23 29 11 34 10 14 35 17

Q2

(Total 12 marks)

Leave blank

3.

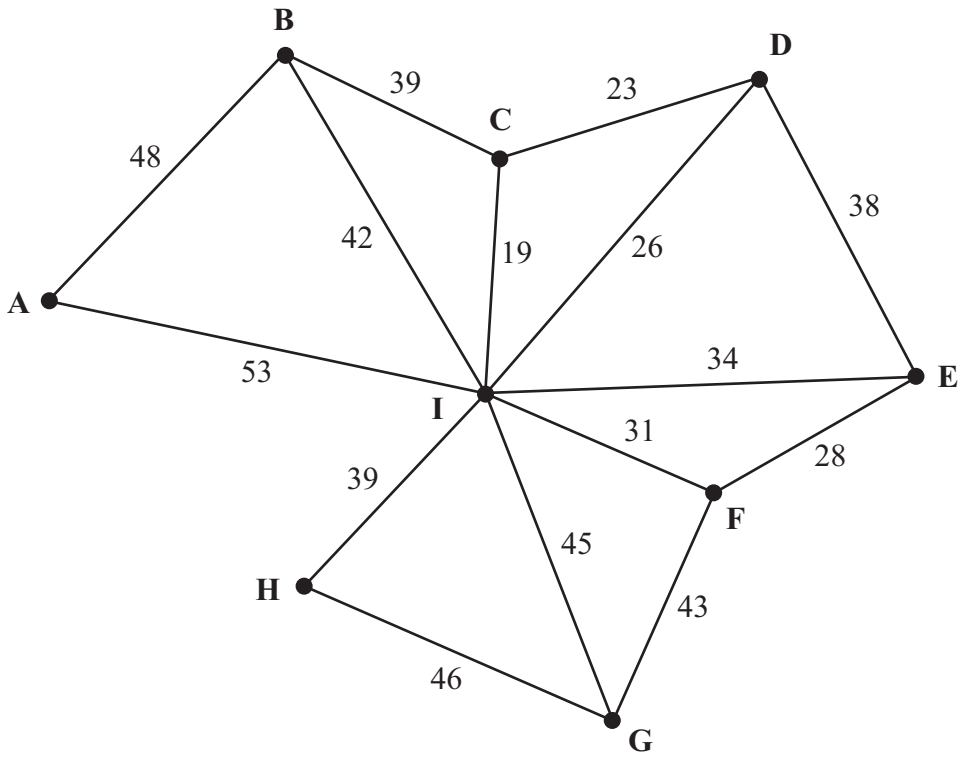


Figure 2

(a)

Leave blank

Question 3 continued

(b)

(c)

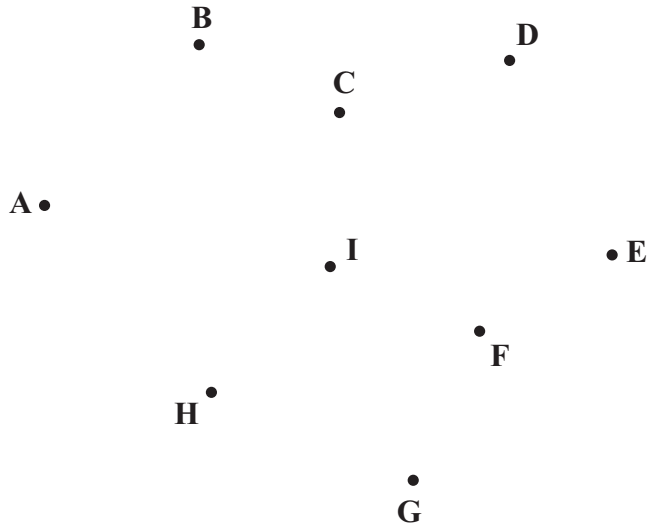


Diagram 1

Weight of minimum spanning tree: _____

(d)

Q3

(Total 10 marks)

Leave blank

4.

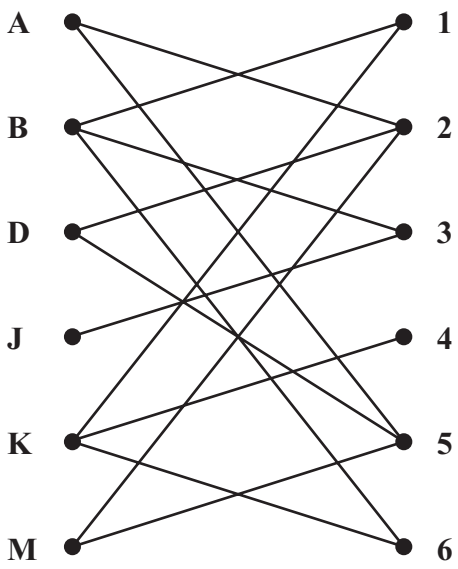


Figure 3

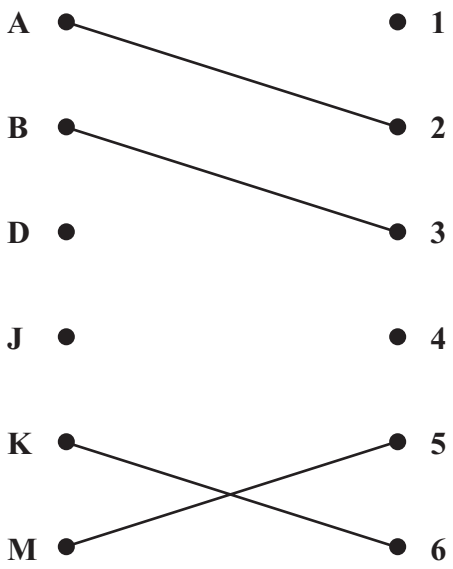
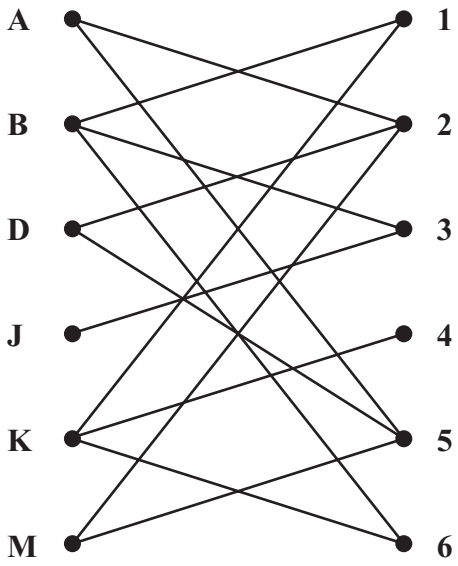
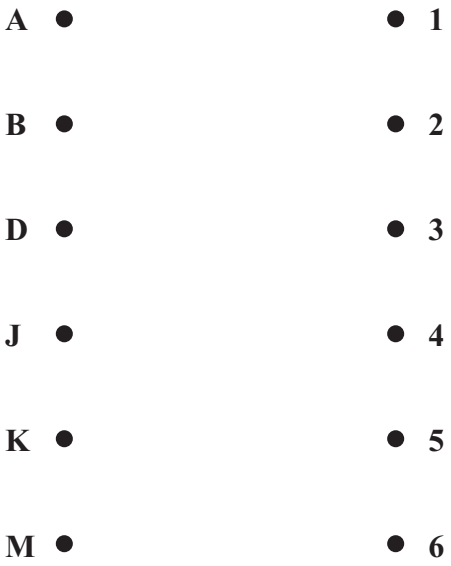


Figure 4

Leave blank

Question 4 continued





Q4

(Total 7 marks)

Leave blank

5.

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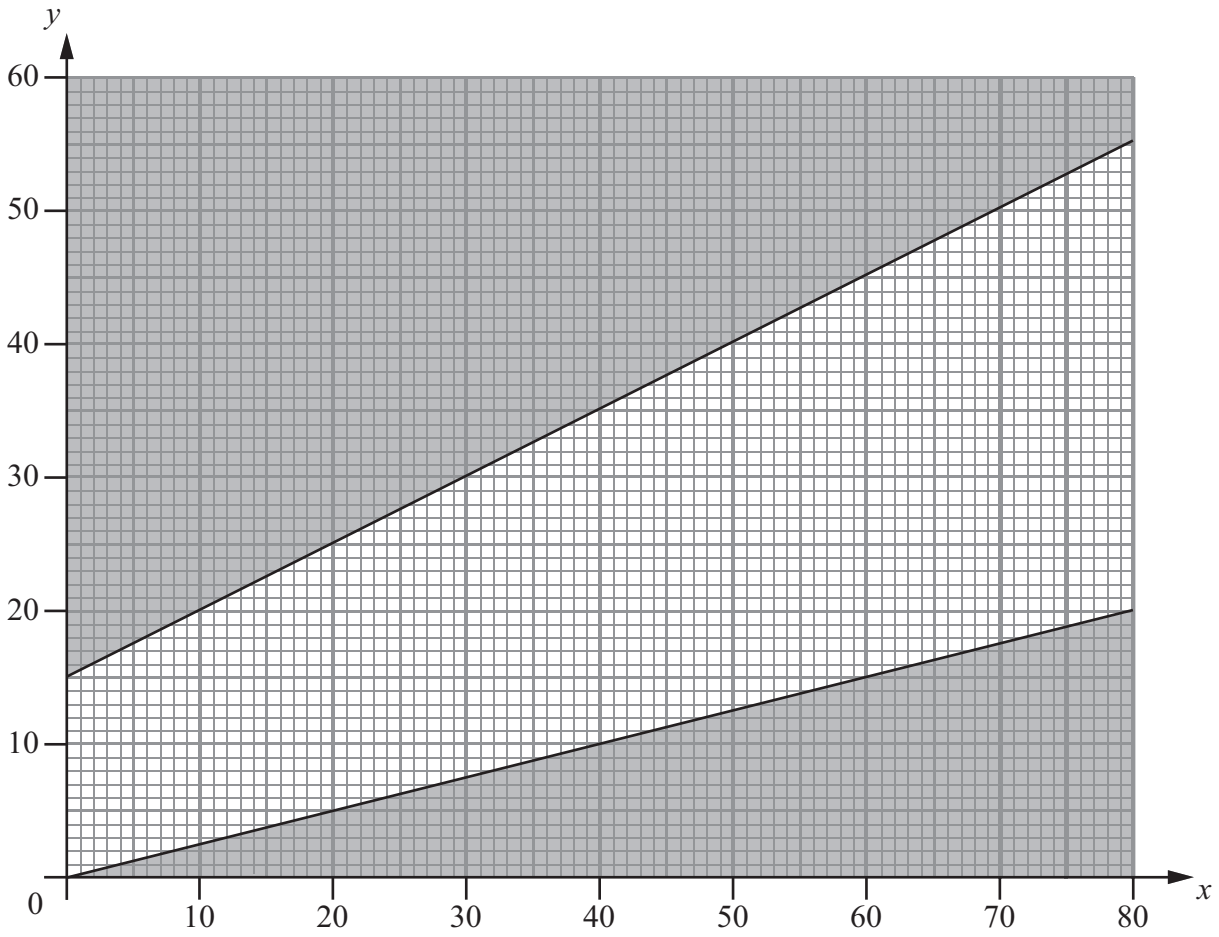
Question 5 continued

Q5

(Total 11 marks)

Leave blank

6.



Graph 1

Leave blank

Question 6 continued

Q6

(Total 11 marks)

Leave blank

7. (a)

Activity	Immediately preceding activities
A	-
B	-
C	A
D	A
E	A
F	B, C
G	
H	
I	
J	
K	
L	

Precedence table

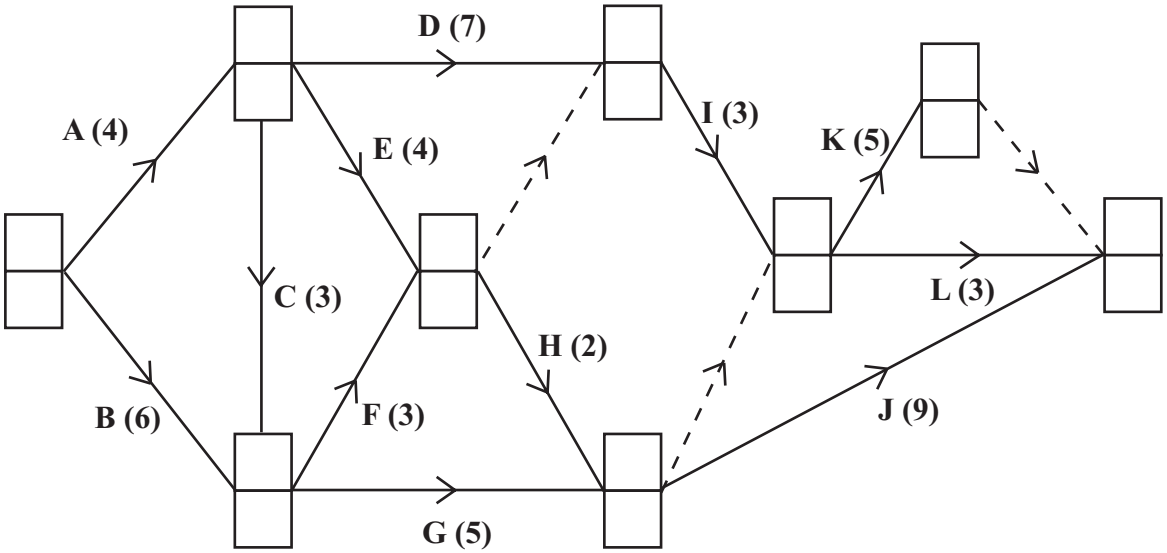
(b)



Leave blank

Question 7 continued

(c)



Key:

Early event time
Late event time

Diagram 2

(d) Critical Activities: _____

(e) _____

_____

_____

(f) _____

_____

_____

Q7

(Total 16 marks)

TOTAL FOR PAPER: 75 MARKS

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