Paper Reference(s)

6689/01

Edexcel GCE

Decision Mathematics D1

Advanced/Advanced Subsidiary

Wednesday 20 May 2009 – 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 8 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.

	A	B	C	D	E	F
A	-	135	180	70	95	225
B	135	-	215	125	205	240
C	180	215	-	150	165	155
D	70	125	150	-	100	195
E	95	205	165	100	-	215
F	225	240	155	195	215	-

The table shows the lengths, in km, of potential rail routes between six towns, A, B, C, D, E and F.

(a) Use Prim's algorithm, starting from A, to find a minimum spanning tree for this table. You must list the **arcs** that form your tree **in the order that they are selected**.

(3)

(b) Draw your tree using the vertices given in Diagram 1 in the answer book.

(1)

(c) State the total weight of your tree.

(1)

(Total 5 marks)

2.

32 45 17 23 38 28 16 9 12 10

The numbers in the list above represent the lengths, in metres, of ten lengths of fabric. They are to be cut from rolls of fabric of length 60m.

(a) Calculate a lower bound for the number of rolls needed.

(2)

(b) Use the first-fit bin packing algorithm to determine how these ten lengths can be cut from rolls of length 60m.

(4)

(c) Use full bins to find an optimal solution that uses the minimum number of rolls.

(3)

(Total 9 marks)

3.

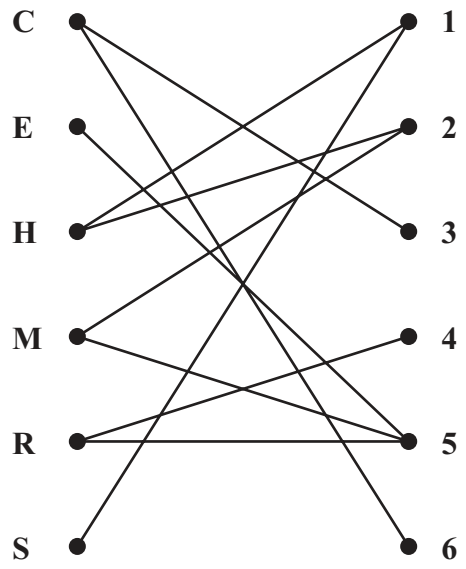

Figure 1

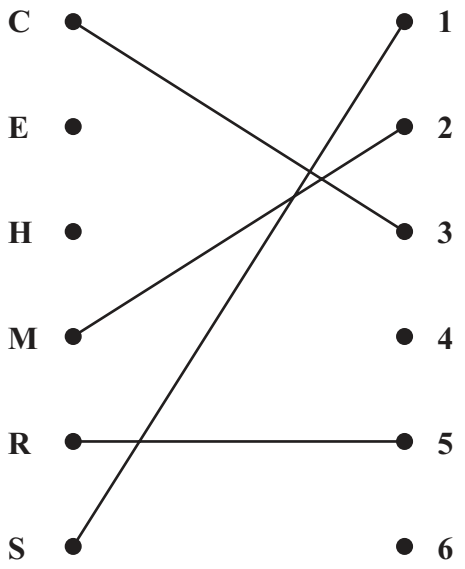

Figure 2

Figure 1 shows the possible allocations of six workers, Charlotte (C), Eleanor (E), Harry (H), Matt (M), Rachel (R) and Simon (S) to six tasks, 1, 2, 3, 4, 5 and 6.
Figure 2 shows an initial matching.

(a) List an alternating path, starting at H and ending at 4. Use your path to find an improved matching. List your improved matching.

(3)

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

(1)

Simon (S) now has task 3 added to his possible allocation.

(c) Taking the improved matching found in (a) as the new initial matching, use the maximum matching algorithm to find a complete matching. List clearly the alternating path you use and your complete matching.

.

(3)

(Total 7 marks)

4.

Miri
Jessie
Edward
Katie
Hegg
Beth
Louis
Philip
Natsuko
Dylan

(a) Use the quick sort algorithm to sort the above list into alphabetical order.

(5)

(b) Use the binary search algorithm to locate the name Louis.

(4)

(Total 9 marks)

5.

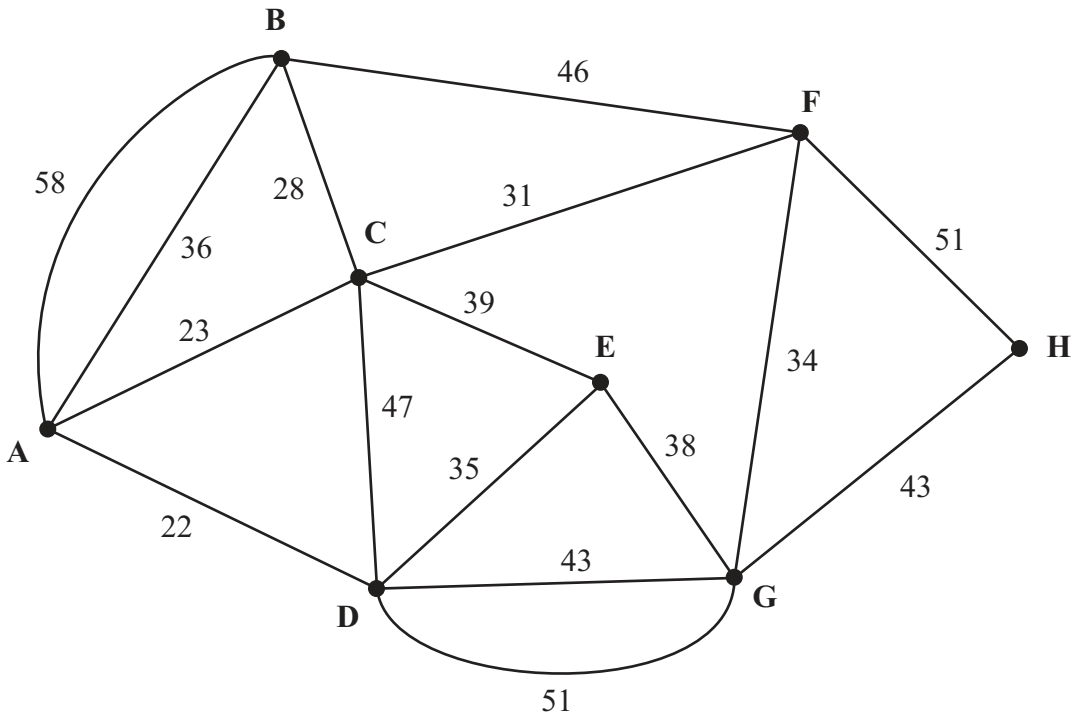

Figure 3

[The total weight of the network is 625 m]

Figure 3 models a network of paths in a park. The number on each arc represents the length, in m, of that path.
Rob needs to travel along each path to inspect the surface. He wants 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)

The surface on each path is to be renewed. A machine will be hired to do this task and driven along each path.
The machine will be delivered to point G and will start from there, but it may be collected from any point once the task is complete.

(b) Given that each path must be traversed at least once, determine the finishing point so that the length of the route is minimised. Give a reason for your answer and state the length of your route.

(3)

(Total 9 marks)

6.

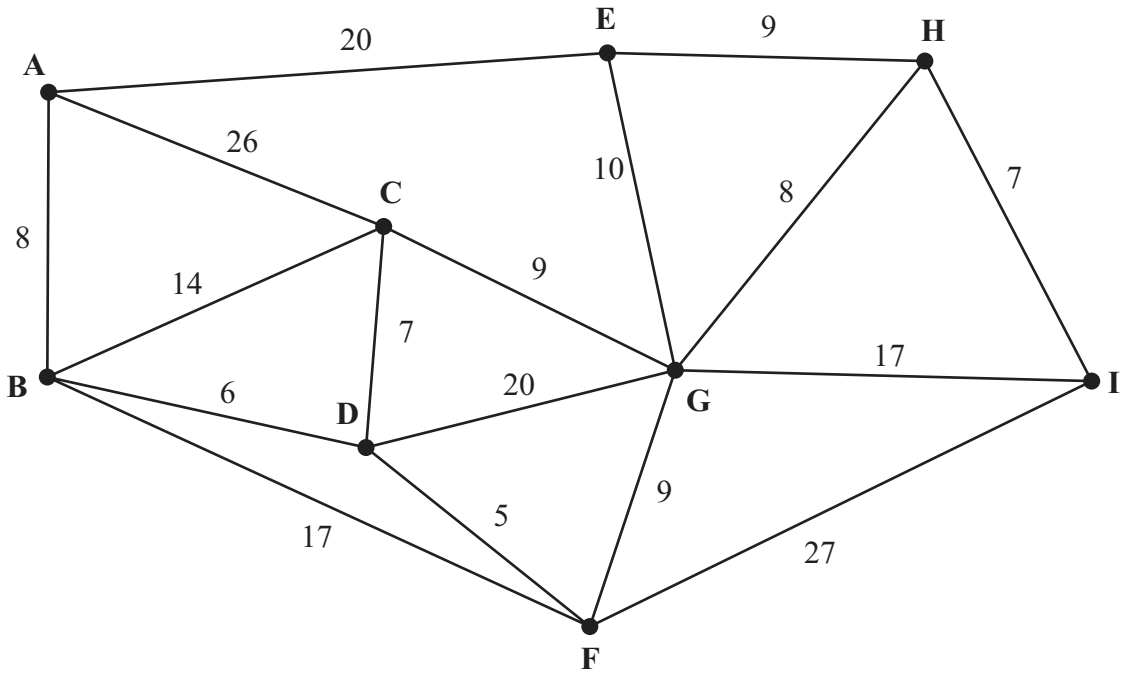

Figure 4

Figure 4 represents a network of roads. The number on each arc gives the length, in km, of that road.

(a) Use Dijkstra's algorithm to find the shortest distance from A to I. State your shortest route.

(6)

(b) State the shortest distance from A to G.

(1)

(Total 7 marks)

7. Rose makes hanging baskets which she sells at her local market. She makes two types, large and small. Rose makes x large baskets and y small baskets.

Each large basket costs £7 to make and each small basket costs £5 to make. Rose has £350 she can spend on making the baskets.

(a) Write down an inequality, in terms of x and y, to model this constraint.

(2)

Two further constraints are

$$y \leqslant 20 \text{ and}$$
$$y \leqslant 4x.$$

(b) Use these two constraints to write down statements that describe the numbers of large and small baskets that Rose can make.

(2)

(c) On the grid provided, show these three constraints and $x \geqslant 0$, $y \geqslant 0$. Hence label the feasible region, R.

(4)

Rose makes a profit of £2 on each large basket and £3 on each small basket. Rose wishes to maximise her profit, £P.

(d) Write down the objective function.

(1)

(e) Use your graph to determine the optimal numbers of large and small baskets Rose should make, and state the optimal profit.

(5)

(Total 14 marks)

8.

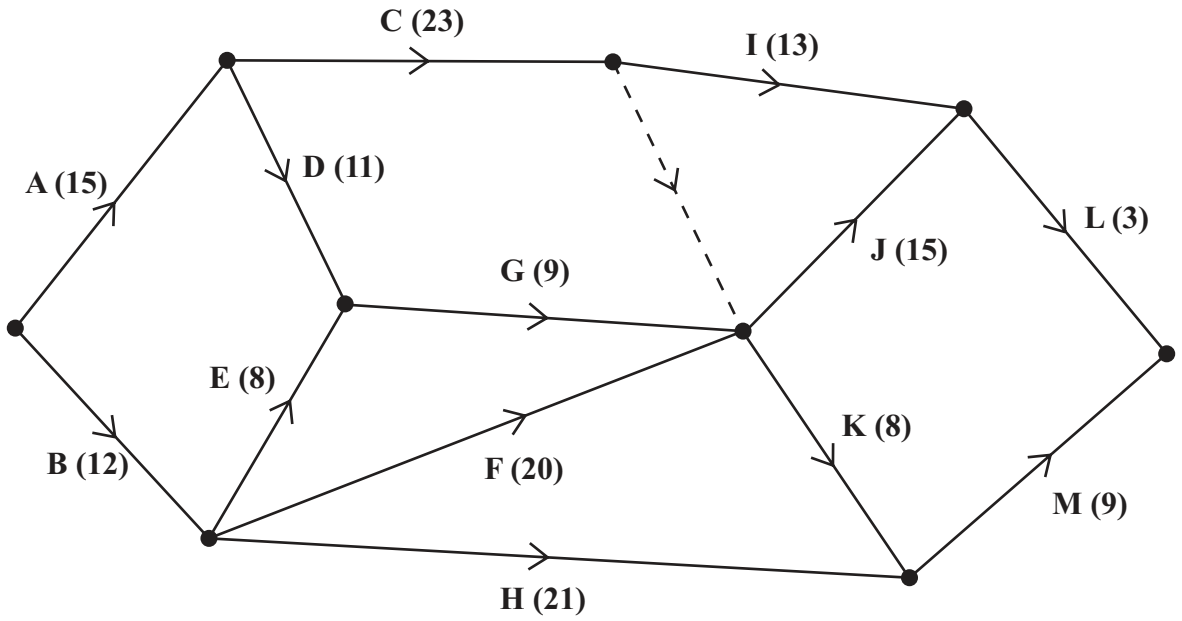

Figure 5

A construction project is modelled by the activity network shown in Figure 5. 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, showing the early and late event times.

(4)

(b) State the critical activities.

(1)

(c) Find the total float for activities M and H. You **must** make the numbers you use in your calculations clear.

(3)

(d) On the grid provided, draw a cascade (Gantt) chart for this project.

(4)

An inspector visits the project at 1pm on days 16 and 31 to check the progress of the work.

(e) Given that the project is on schedule, which activities **must** be happening on each of these days?

(3)

(Total 15 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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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	
8	
Total	

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1. (a)

	A	B	C	D	E	F
A	-	135	180	70	95	225
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C	180	215	-	150	165	155
D	70	125	150	-	100	195
E	95	205	165	100	-	215
F	225	240	155	195	215	-

(b)

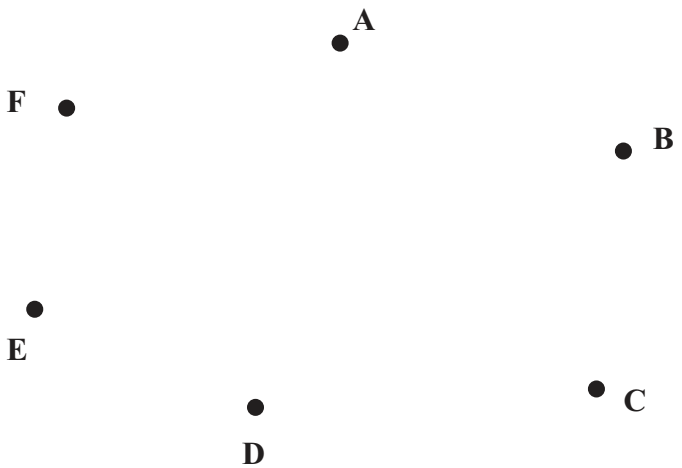

Diagram 1

(c) Total weight of tree _____

Q1

(Total 5 marks)

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2.

Q2

(Total 9 marks)

Leave blank

3.

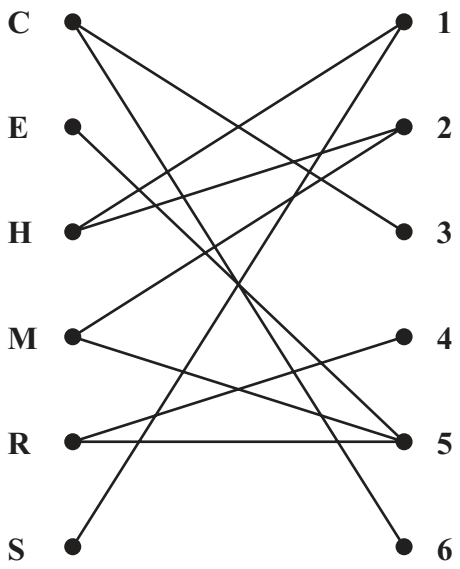

Figure 1

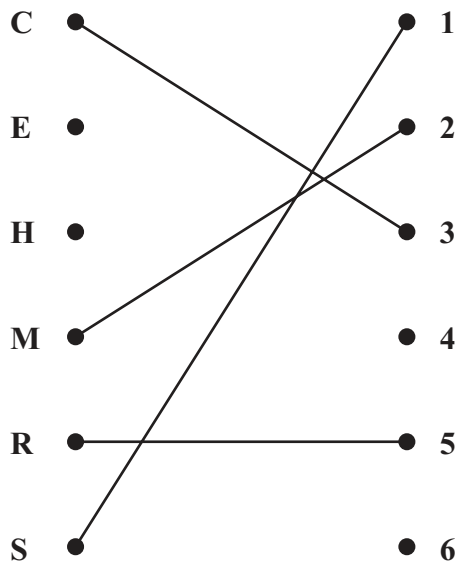

Figure 2

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(Question 3 continued)

C ●	● **1**
E ●	● **2**
H ●	● **3**
M ●	● **4**
R ●	● **5**
S ●	● **6**

Q3

(Total 7 marks)

Leave blank

4.

Leave blank

(Question 4 continued)

Q4

(Total 9 marks)

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5.

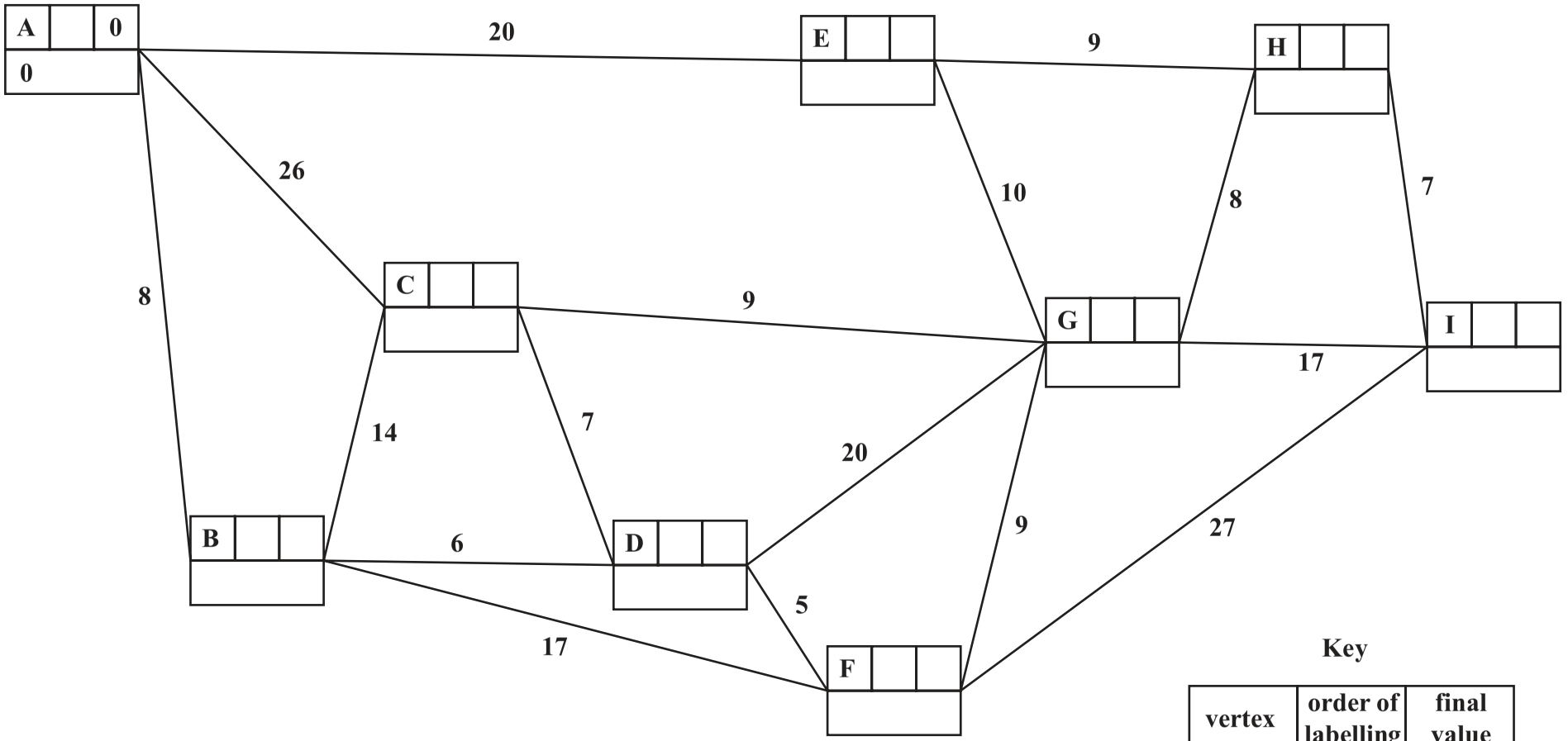
Leave blank

(Question 5 continued)

Q5

(Total 9 marks)

6. (a)



Shortest route _____

(b) Shortest distance A to G _____

(Total 7 marks)

Q6

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7.

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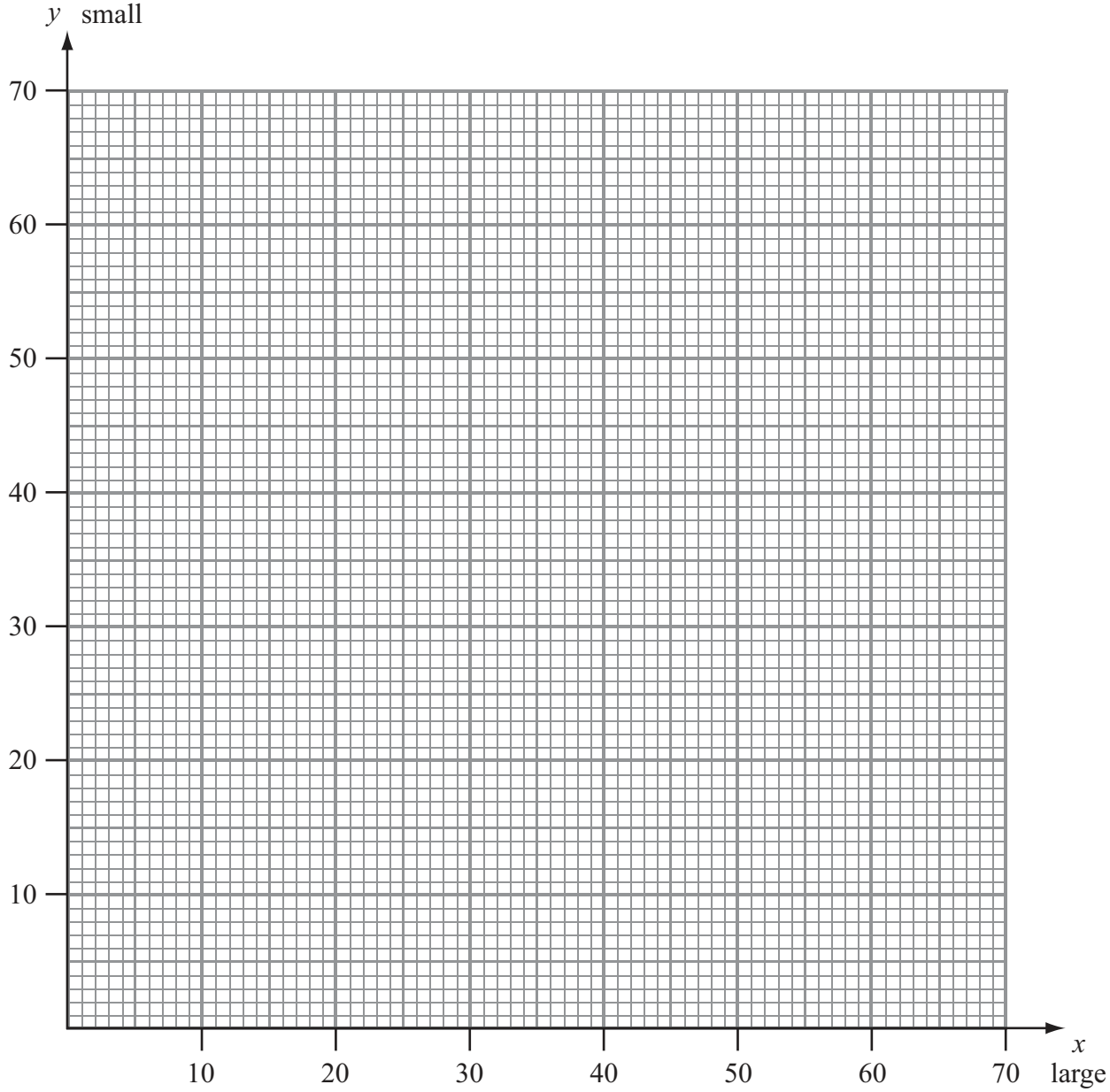
(Question 7 continued)



Q7

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8. (a)

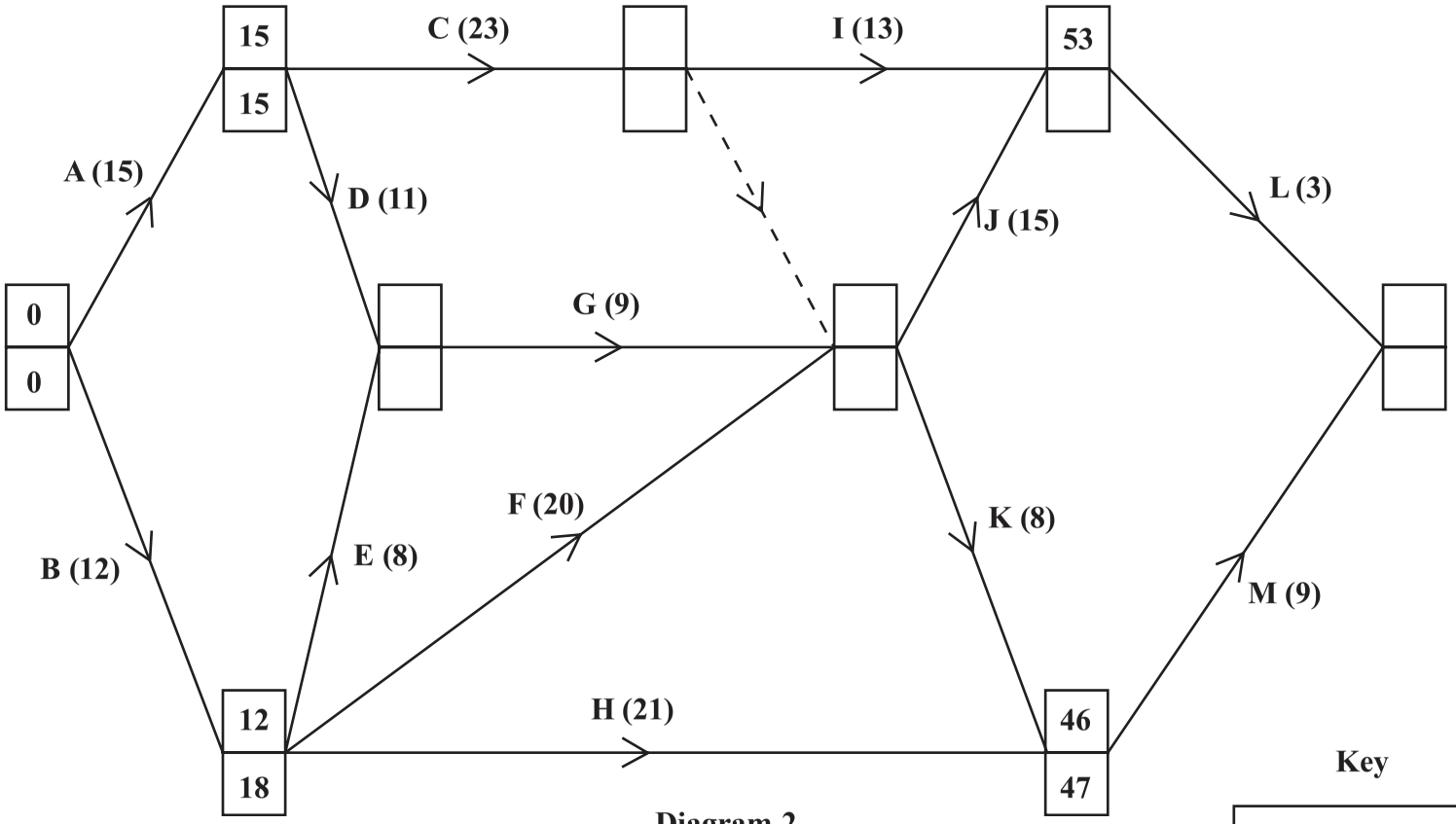

Diagram 2

(b) Critical activities _____

(c) _____

_____

_____

_____

_____

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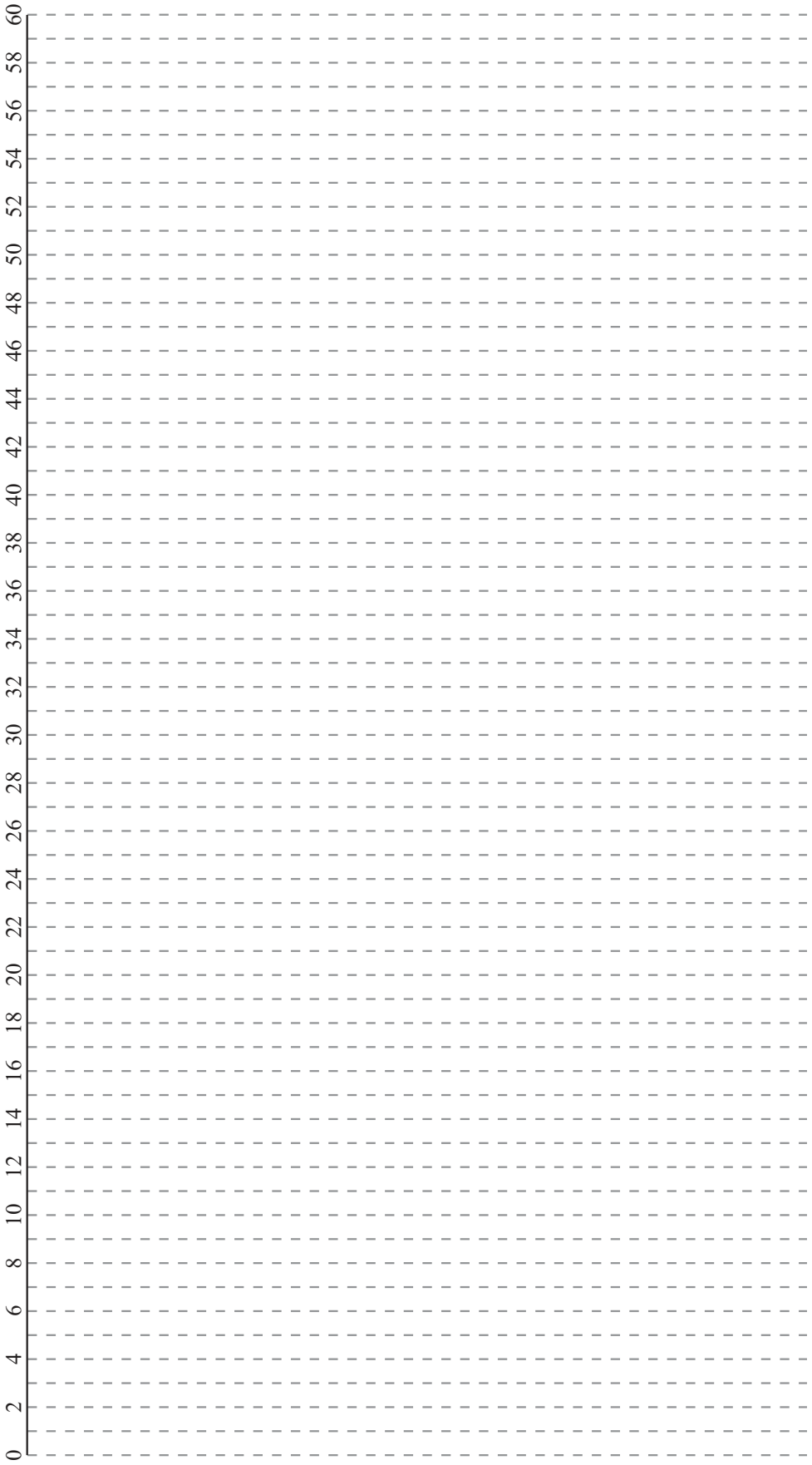
Leave blank

(Question 8 continued)

(d)



(e) Day 16

Day 31

Q8

(Total 15 marks)

TOTAL FOR PAPER: 75 MARKS

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