Pearson Edexcel International Advanced Level

Tuesday 20 January 2026

Afternoon (Time: 1 hour 30 minutes) | Paper reference **WDM11/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Decision Mathematics D1

You must have:
Decision Mathematics Answer Book (enclosed), calculator

Candidates may use any calculator allowed by Pearson regulations. 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** at the top of the answer book with your name, centre number and candidate number.
- Do not return the question paper with the answer book.
- 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.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- There are 8 questions in this question paper. 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

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P 7 8 9 8 7 A

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

1. In the following list, eleven sports are identified by their initial letter

(V) Volleyball

(H) Handball

(W) Wheelchair basketball

(B) Baseball

(R) Rugby

(G) Golf

(C) Cricket

(P) Paratriathlon

(T) Tennis

(D) Diving

(S) Squash

(a) Explain why a binary search cannot be performed on this list in its current form.

(1)

(b) Write the list in an appropriate form and show how a binary search is used to try to locate (F) Football. You must make your choice of pivots clear.

(4)

(Total for Question 1 is 5 marks)

2.

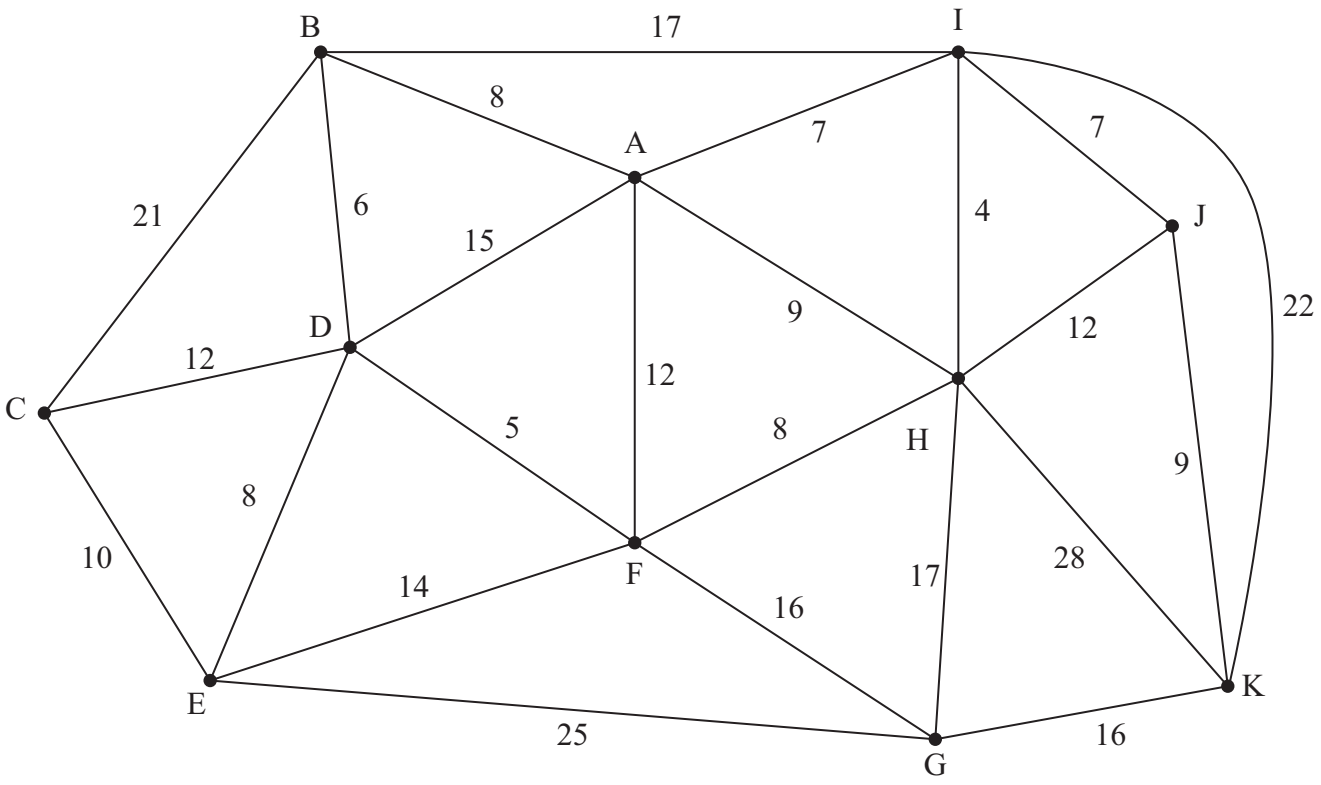


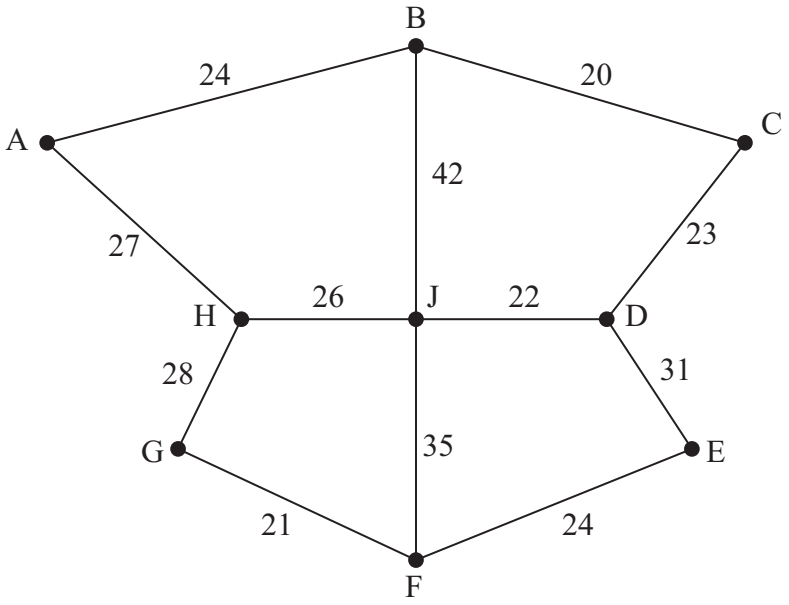
Figure 1

Figure 1 shows a network of paths between eleven viewing points in a bird sanctuary. The number on each arc represents the time taken, in minutes, to walk between the viewing points.

Use Dijkstra's algorithm to determine the quickest route from C to K. You should state the route and the quickest time.

(Total for Question 2 is 6 marks)

3.



(*Total weight 323 metres*)

Figure 2

Figure 2 represents a network connecting nine locations. The number on each arc is the distance in metres between the corresponding locations.

(i) (a) Explain how Kruskal's algorithm can be adapted to obtain a spanning tree of least weight that contains a specific arc.

(1)

Using the adaptation of Kruskal's algorithm from part (i)(a) on the network in Figure 2,

(b) find the spanning tree of least weight **that includes arc BJ**.
You must show your working and clearly state the order in which arcs are added.

(3)

(c) State the weight of the spanning tree found in part (i)(b).

(1)

(ii) An engineer needs to inspect the network in Figure 2. Her route must start and finish at A. She must travel along each arc at least once, minimising the length of her route.

(a) Determine the length of the engineer's route. You must make your method clear and state the arcs which need to be repeated.

(5)

On another day the engineer decides to start her route at F and end at J. She must travel along each arc at least once, minimising the length of her route.

(b) Determine how much shorter this route is than the route obtained in part (ii)(a). You must make your working clear.

(3)

(Total for Question 3 is 13 marks)

4. The following list of eleven **distinct integers** is to be sorted into ascending order.

44	35	73	x	24	58	32	21	61	54	31

The first two passes of bubble sort are

35	44	x	24	58	32	21	61	54	31	73
35	44	24	x	32	21	58	54	31	61	73

(a) Explain why x must satisfy the inequality $45 \leqslant x \leqslant 57$

(2)

(b) Carry out one more pass of bubble sort, showing the result at the end of the pass.

(2)

Given that

- when the numbers are placed in bins of size 120, the lower bound for the number of bins required is five
- when the first-fit decreasing algorithm is used to place the numbers in bins of size 160, x is placed in the second bin, which also contains 54

(c) determine the value of x. You must make your reasoning clear.

(3)

(Total for Question 4 is 7 marks)

5. A carpenter produces three sizes of table, small, medium and large.

The information below shows the quantity of wood required for each size of table, the production time, the profit on each table and the totals available.

	Quantity of wood required	**Production time**	**Profit**
Small	1.2 m^2	4 hours 20 minutes	£275
Medium	2.5 m^2	7 hours 30 minutes	£425
Large	4.0 m^2	9 hours	£650
Total available	60 m^2	200 hours	

The tables produced should meet the following conditions

- at least 40% of the tables must be small
- there must be at least twice as many small tables as medium tables
- no more than 30% of the tables must be large

The carpenter wishes to maximise the profit from the sale of the tables.

Let x be the number of small tables, y be the number of medium tables and z be the number of large tables produced.

Formulate this as a linear programming problem. You should clearly state the objective function and give the constraints as simplified inequalities with integer coefficients.

(Total for Question 5 is 8 marks)

6.

	A	B	C	D	E	F	G	H
A	-	24	19	28	25	32	29	31
B	24	-	22	31	25	23	37	41
C	19	22	-	18	21	41	31	35
D	28	31	18	-	24	21	27	26
E	25	25	21	24	-	17	31	25
F	32	23	41	21	17	-	26	31
G	29	37	31	27	31	26	-	24
H	31	41	35	26	25	31	24	-

The table shows the least distances, in km, between eight towns. Imani wants to visit all eight towns. She needs to find a route which minimises the distance travelled, starting and finishing at A.

(a) Show that there are two nearest neighbour routes starting at A. You must make your method clear and state the routes and their lengths.

(4)

(b) State, giving a reason, which route from part (a) gives the better upper bound for the length of Imani's route.

(1)

(c) By deleting A and all of its arcs, use Prim's algorithm, starting at B, to obtain a lower bound for the length of Imani's route. You must show your working.

(4)

A second lower bound of 172 km is obtained by deleting H.

(d) Write down the smallest interval that must contain the optimal length for Imani's route.

(1)

(Total for Question 6 is 10 marks)

7.

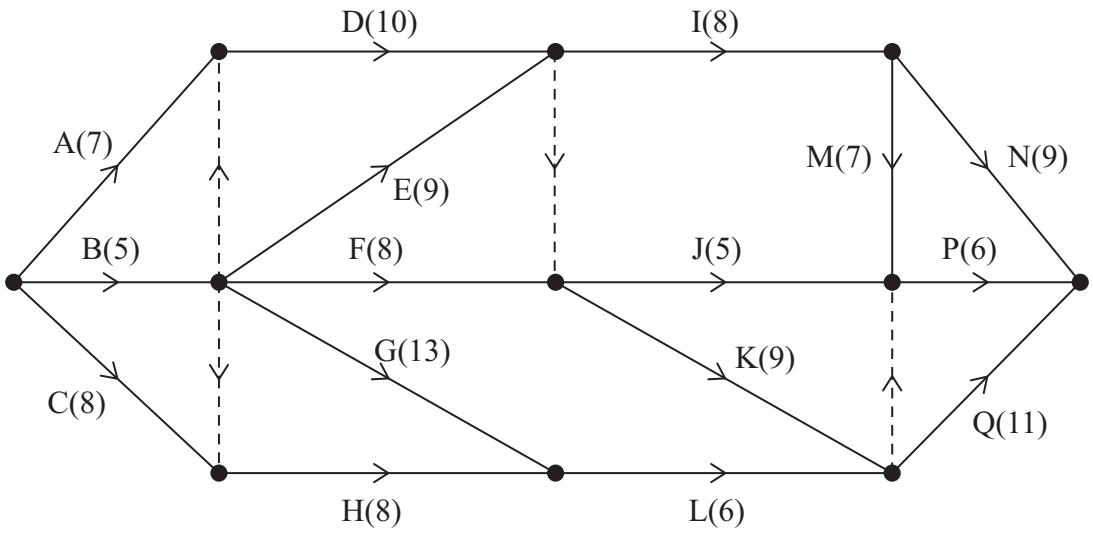


Figure 3

A project is modelled by the activity network shown in Figure 3. 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 exactly one worker. The project is to be completed in the shortest possible time.

(a) Complete the table in the answer book to show the immediately preceding activities for the network.

(3)

(b) Complete the diagram in the answer book to show the early event times and the late event times.

(4)

(c) State the critical activities.

(1)

(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 the answer book, draw a schedule to show how the activities can be completed in the minimum time, using the minimum number of workers.

(4)

(Total for Question 7 is 14 marks)

8. A linear programming problem is formulated as follows

Maximise $P = 6x + 5y$

Subject to $y \leqslant 3x + 10$

$x + 4y \leqslant 162$

$5x + 2y \leqslant 200$

$y \geqslant 15$

$x \geqslant 0$

(a) Complete the graph in the answer book to show these inequalities, shading those regions which are **not** included in the feasible region. Label the feasible region R

(3)

(b) Use the vertex method to determine the exact coordinates of the optimal vertex.

(4)

(c) The practical solution to this problem requires integer solutions. Determine the optimal solution and state the value of the objective function.

(3)

The objective function is now changed to

$$P = kx + y$$

where k is a constant.

(d) Determine the range of values for k for which the optimal vertex is unchanged.

(2)

(Total for Question 8 is 12 marks)

TOTAL FOR PAPER IS 75 MARKS

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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

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Answer Book
Do not return the question paper with the answer book.

Total Marks

Turn over ▶

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1.

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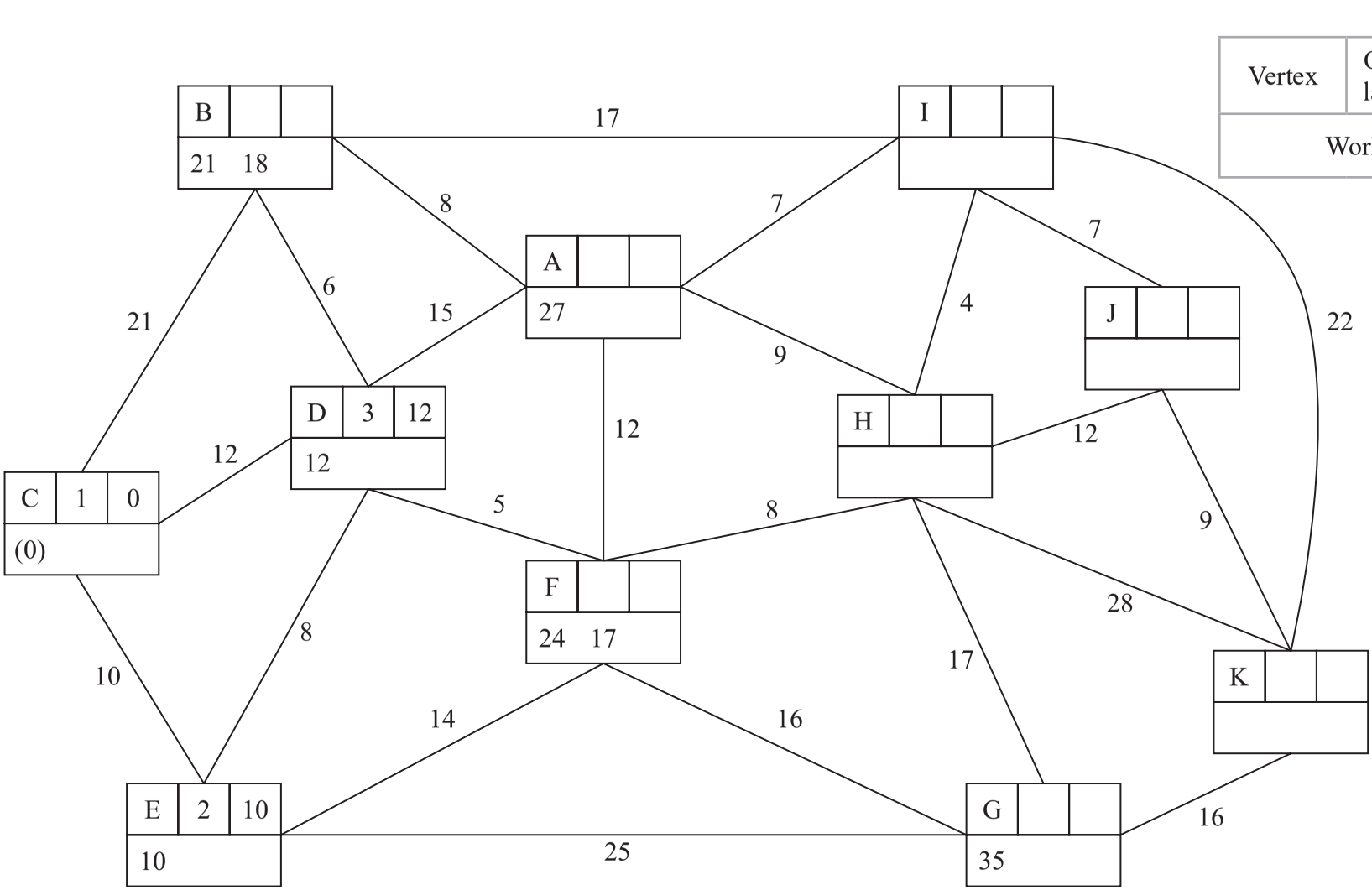
Question 1 continued

(Total for Question 1 is 5 marks)

2.



Quickest route from C to K: _____

Quickest time from C to K: _____

(Total for Question 2 is 6 marks)

3.

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Question 3 continued

Question 3 continued

(Total for Question 3 is 13 marks)

4.

44	35	73	x	24	58	32	21	61	54	31
35	44	x	24	58	32	21	61	54	31	73
35	44	24	x	32	21	58	54	31	61	73

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Question 4 continued

(Total for Question 4 is 7 marks)

5.

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 5 continued

(Total for Question 5 is 8 marks)

6.

	A	B	C	D	E	F	G	H
A	-	24	19	28	25	32	29	31
B	24	-	22	31	25	23	37	41
C	19	22	-	18	21	41	31	35
D	28	31	18	-	24	21	27	26
E	25	25	21	24	-	17	31	25
F	32	23	41	21	17	-	26	31
G	29	37	31	27	31	26	-	24
H	31	41	35	26	25	31	24	-

Question 6 continued

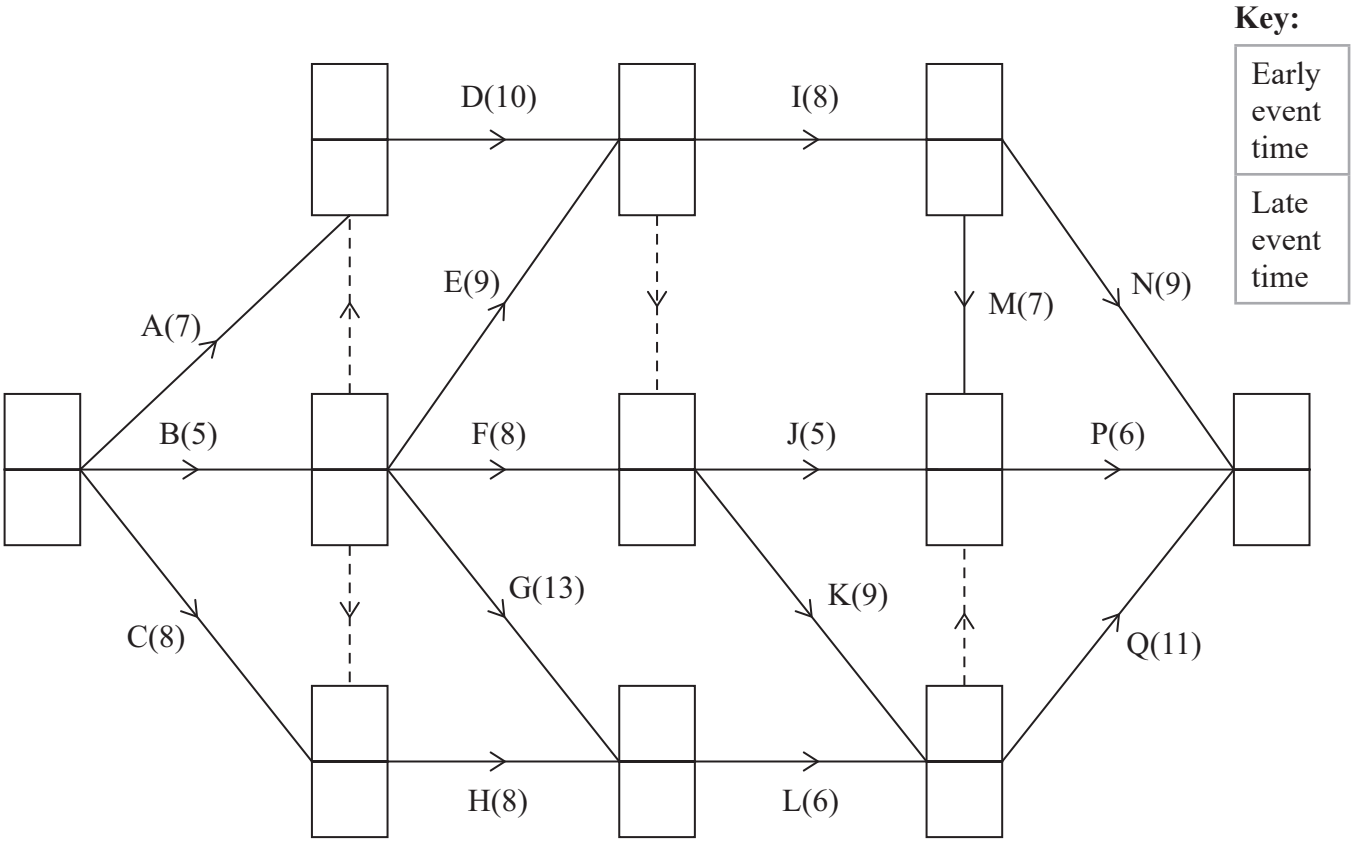
	A	B	C	D	E	F	G	H
A	-	24	19	28	25	32	29	31
B	24	-	22	31	25	23	37	41
C	19	22	-	18	21	41	31	35
D	28	31	18	-	24	21	27	26
E	25	25	21	24	-	17	31	25
F	32	23	41	21	17	-	26	31
G	29	37	31	27	31	26	-	24
H	31	41	35	26	25	31	24	-

(Total for Question 6 is 10 marks)

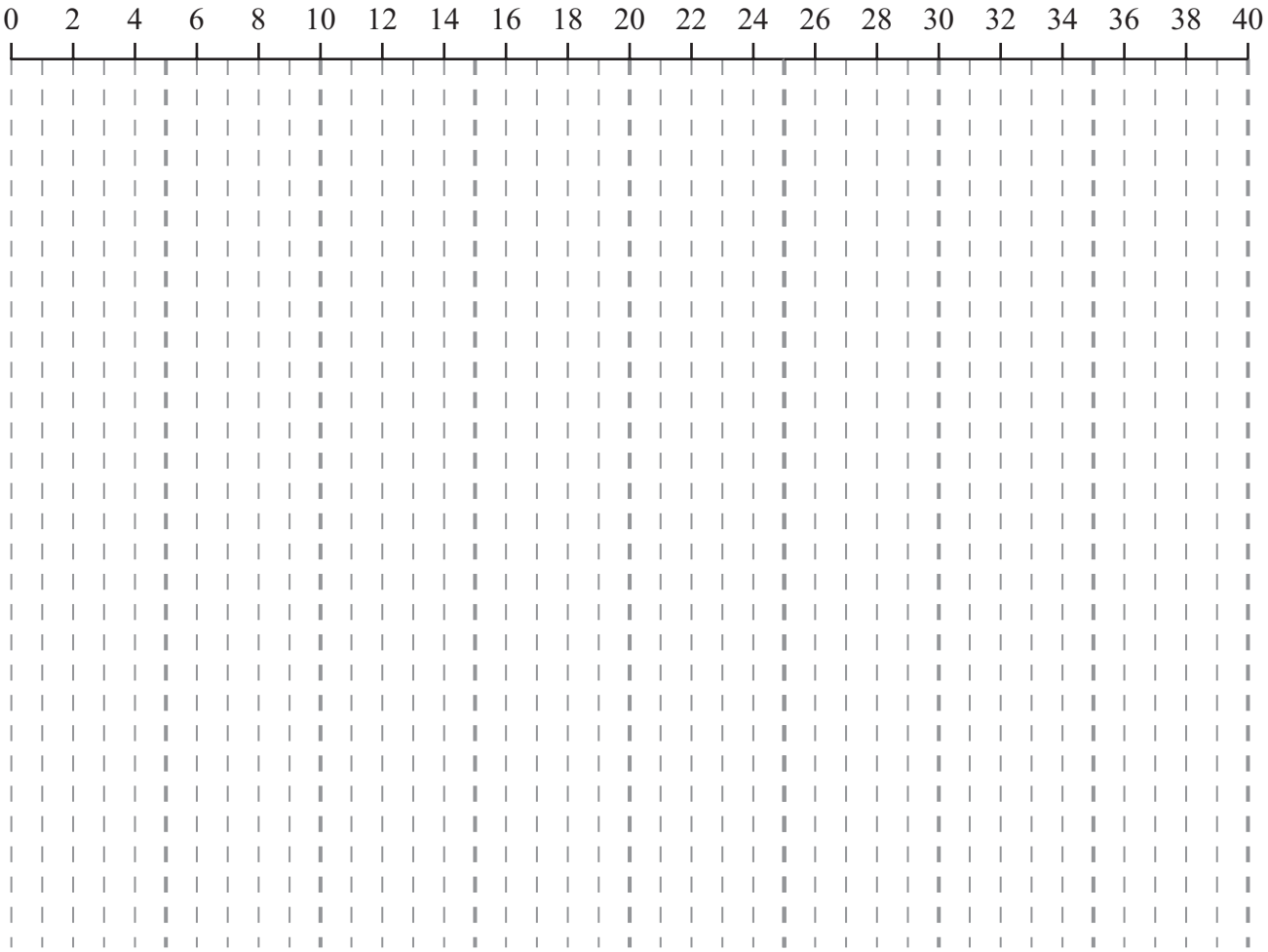
7.

Activity	Immediately preceding activities
A	-
B	-
C	-
D	A B
E	B
F	B
G	B
H	
I	
J	
K	
L	
M	
N	
P	
Q	

Question 7 continued

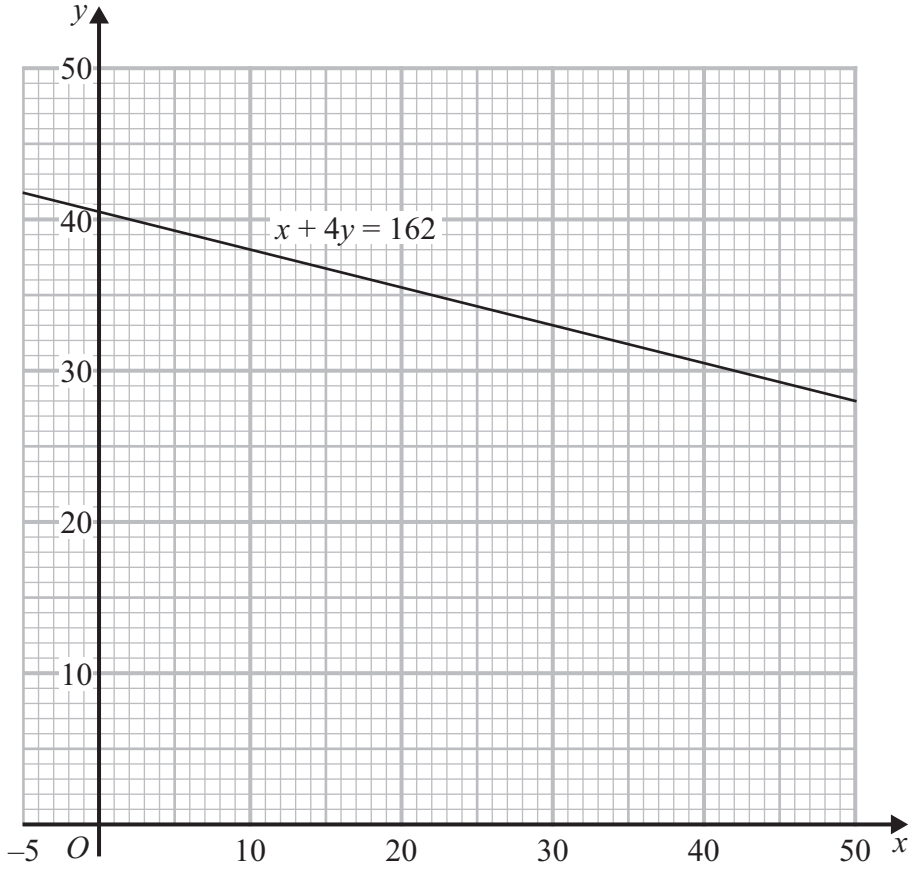


Question 7 continued



(Total for Question 7 is 14 marks)

8.



There is a copy of these axes on page 20 if you need to redraw your diagram.

Question 8 continued

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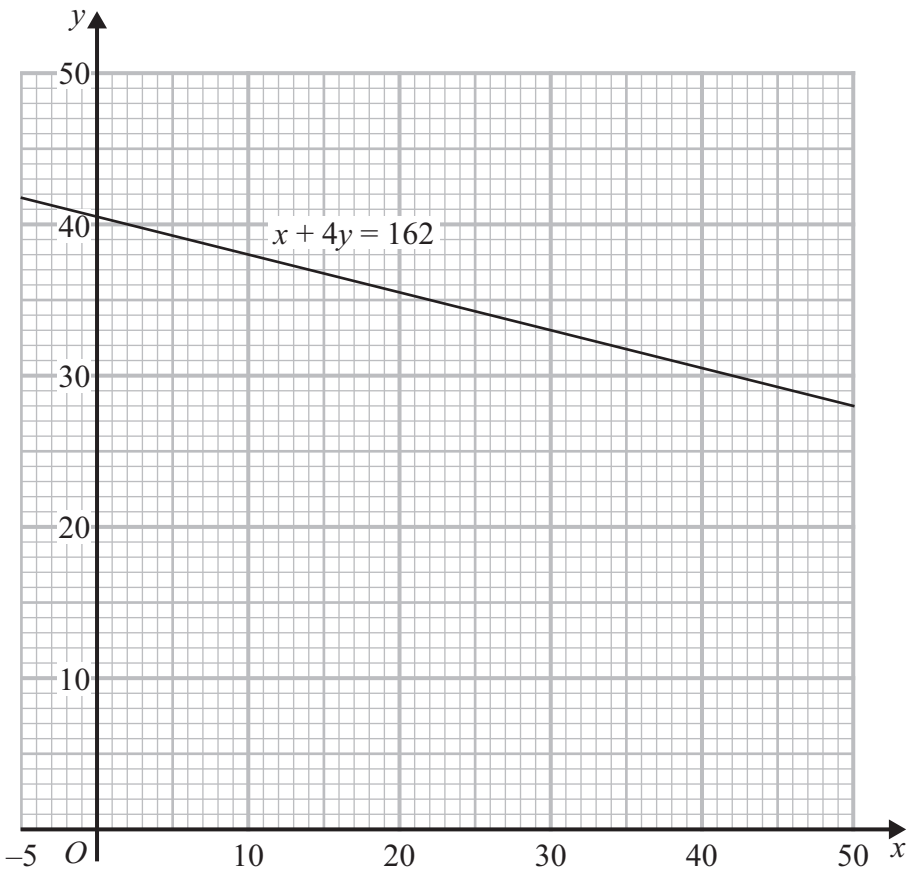
Question 8 continued

Question 8 continued

Only use this copy of the axes if you need to redraw your diagram.



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