

Pearson Edexcel International Advanced Level

Thursday 14 May 2026

Morning (Time: 1 hour 30 minutes)

**Paper
reference**

WDM11/01A

Mathematics

International Advanced Subsidiary/Advanced Level

Decision Mathematics D1

Question Paper

You must have:

Answer book (sent separately).

Do not return this question paper with the answer book.

Turn over ►

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1. The following list of ten numbers is to be sorted into ascending order.

18 13 21 17 23 14 20 15 16 19

(a) Use bubble sort to sort the list into ascending order. You should only show the result of each pass.

(3)

(b)

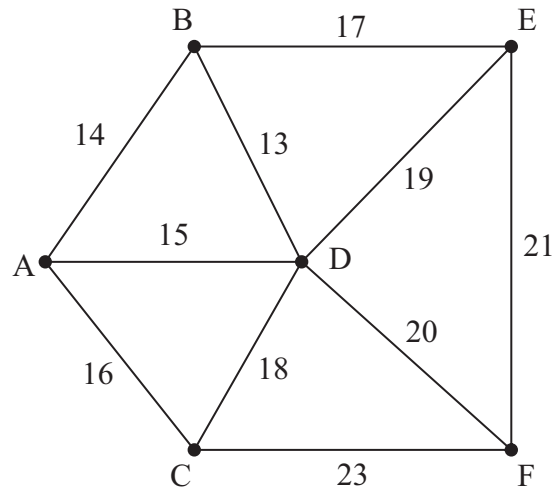


Figure 1

The list of ten numbers in part (a) represents the lengths of cables, in metres, that connect six workstations, as shown in Figure 1.

The workstations must be connected using the minimum amount of cabling.

(i) Use Kruskal's algorithm to find the minimum spanning tree for the network. You must clearly show the order in which the arcs are selected.

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

(4)

(Total for Question 1 is 7 marks)

2.

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

- (a) Draw the activity network described in the precedence table above, using activity on arc and the minimum number of dummies.

(5)

Given that all of the activities have the same duration,

- (b) determine the critical activities.

(2)

(Total for Question 2 is 7 marks)

3.

28 12 15 24 20 13 16 7 11

The nine numbers above are to be packed into bins of size n , where n is an unknown integer.

When the first-fit bin packing algorithm is used, the numbers are packed as follows

Bin 1	28	12	7
Bin 2	15	24	11
Bin 3	20	13	16

(a) Determine the possible values of n

(3)

When the first-fit decreasing bin packing algorithm is used, **four** bins are required.

(b) Determine the value of n , justifying your answer.

(2)

(Total for Question 3 is 5 marks)



4.

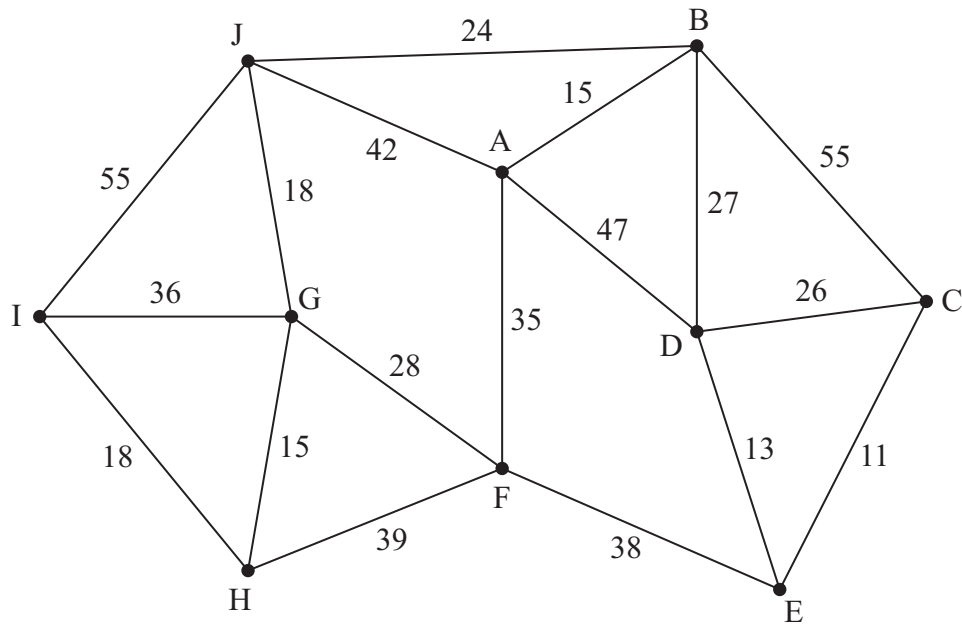


Figure 2

Figure 2 represents the cycle paths between ten towns, A, B, C, D, E, F, G, H, I and J. The number on each arc is the time, in minutes, to cycle between the towns. Munira must cycle from I to C travelling via A.

- (a) Explain how Dijkstra's algorithm can be used to find the quickest route from I to C travelling via A. (2)
- (b) (i) Use Dijkstra's algorithm to find the quickest route from I to C via A. (6)
- (ii) State the length of this quickest route.

(Total for Question 4 is 8 marks)

5.

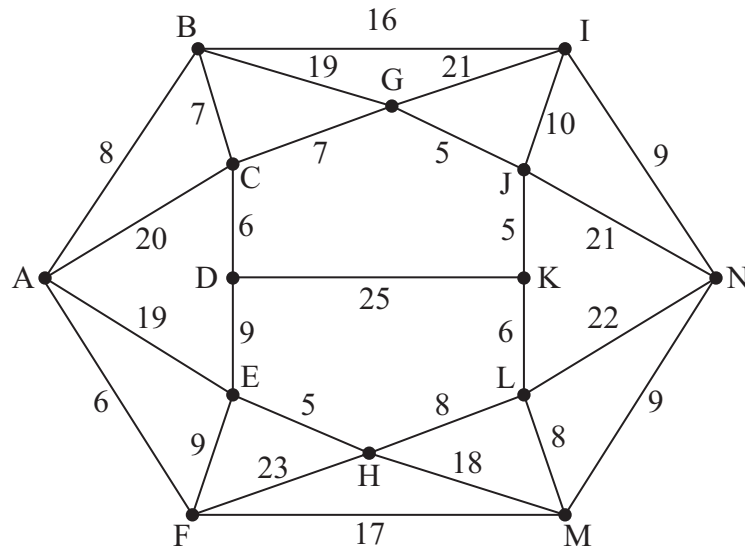


Figure 3

[Total weight of network = 338]

Figure 3 shows the roads between 14 towns. The number on each arc represents the distance, in kilometres, along the corresponding road.

- (a) State, with a reason, whether the network is Eulerian, semi-Eulerian or neither. (1)

The roads between the towns need to be inspected. Jose must travel along each road at least once. He wishes to minimise the length of his inspection route. Jose will start and finish his inspection route at A.

- (b) (i) Determine the length of Jose's route.
(ii) State the roads that Jose must repeat. (3)

Jose now decides to start his inspection route at A and finish at N. He must still minimise the length of his route and travel along each road at least once.

- (c) (i) By considering the pairings of all relevant nodes, determine the length of Jose's route.
(ii) State the roads that he must repeat. (5)

(Total for Question 5 is 9 marks)

6.

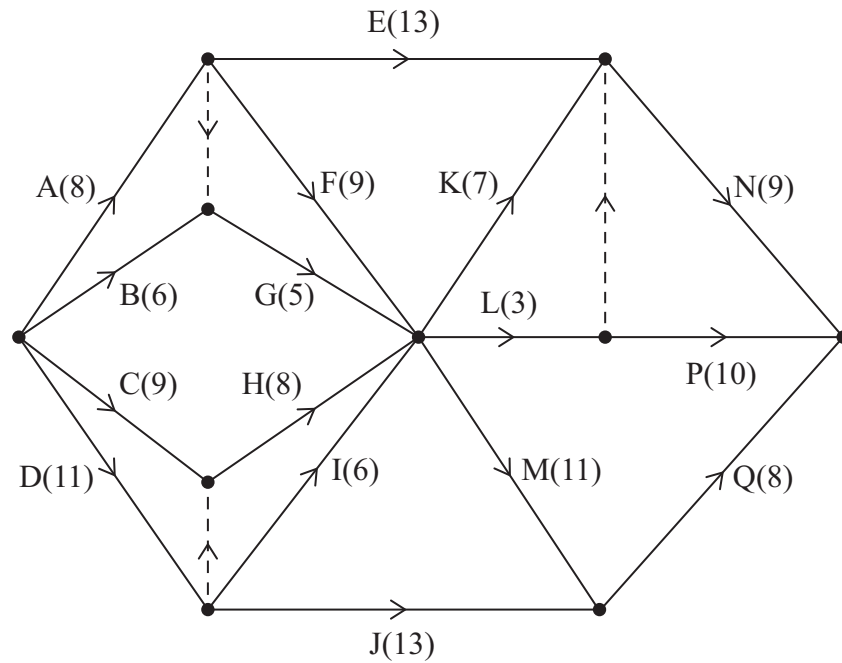


Figure 4

A project is modelled by the activity network shown in Figure 4. The activities are represented by the arcs. The number in brackets on each arc gives the time, in days, to complete the corresponding activity. Each activity requires exactly one worker. The project is to be completed in the shortest possible time.

- Complete the diagram in the answer book to show the early event times and the late event times. (4)
- State the critical activities. (1)
- Calculate a lower bound for the minimum number of workers required to complete the project in the shortest possible time. (2)
- Calculate the total float for activity L, showing your working. (1)
- Draw a schedule on the grid in the answer book to show how the project can be completed in the shortest possible time using the minimum number of workers. (4)

(Total for Question 6 is 12 marks)

7.

	A	B	C	D	E	F	G	H
A	–	43	38	52	44	39	57	48
B	43	–	41	39	50	46	36	43
C	38	41	–	48	53	44	51	45
D	52	39	48	–	43	52	47	49
E	44	50	53	43	–	50	42	46
F	39	46	44	52	50	–	48	54
G	57	36	51	47	42	48	–	42
H	48	43	45	49	46	54	42	–

The table above shows the shortest distance, in miles, between eight towns, A, B, C, D, E, F, G and H.

A delivery driver must visit each town at least once and return to the starting point. The driver wishes to minimise the total distance travelled.

- (a) (i) Using Prim's algorithm, starting at **D**, obtain a minimum spanning tree for the network. You must clearly state the order in which you select the arcs of your tree.
- (ii) State the weight of the tree. (3)
- (b) Draw the minimum spanning tree on the diagram in the answer book. (1)
- (c) Use your answer to part (a) to determine an initial upper bound for the length of the delivery driver's route. (1)
- (d) Use one shortcut, starting from **B**, to obtain an improved upper bound with a length less than 500 miles, stating the shortcut used and the length of the improved upper bound. (2)
- (e) Show that there are two nearest neighbour routes starting from **A**, stating both routes and their lengths. (3)



Question 7 continued

- (f) By deleting **H** and all of its arcs, calculate a lower bound for the length of the delivery driver's route. (2)

A second lower bound of 321 miles is calculated by deleting **A** and all of its arcs.

- (g) Write down the smallest interval that must contain the length of the delivery driver's route. (1)

(Total for Question 7 is 13 marks)

8. The objective for a linear programming problem is

$$\text{Maximise } P = 5x + y + 10z$$

It is known that $x + y + z = 100$

(a) Show that the objective can be written as

$$\text{Minimise } C = 5x + 9y \quad (3)$$

The constraints for the problem are

$$2x + 7y \geq 70$$

$$6x + 7y \leq 210$$

$$7x + 3y \geq 105$$

$$x \leq 3y$$

$$x, y \geq 0$$

(b) Draw the constraints on the grid in the answer book, shading to leave the feasible region, which should be labelled R . (3)

(c) Use point testing to determine the exact coordinates of the optimal vertex. (4)

Given that the original problem requires integer solutions,

(d) determine the optimal values of x , y and z and state the value of P . (4)

(Total for Question 8 is 14 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	

Pearson Edexcel International Advanced Level

Thursday 14 May 2026

Morning (Time: 1 hour 30 minutes)

Paper reference **WDM11/01A**

Mathematics

International Advanced Subsidiary/Advanced Level

Decision Mathematics D1

Answer book

You must have:

Question paper (sent separately)

Calculator

Total Marks

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 this page 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 spaces 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.

Turn over ►

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Question 1

Write the answer to Question 1 on these 4 pages

18 13 21 17 23 14 20 15 16 19

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DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

Question 1 continued

18 13 21 17 23 14 20 15 16 19

Handwriting practice area with 20 horizontal lines.



Question 1 continued

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA



Question 2

Write the answer to Question 2 on these 2 pages

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DO NOT WRITE IN THIS AREA

(Total for Question 2 is 7 marks)



Question 3

Write the answer to Question 3 on these 2 pages

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[illegible]

Question 4

Write the answer to Question 4 on these 2 pages

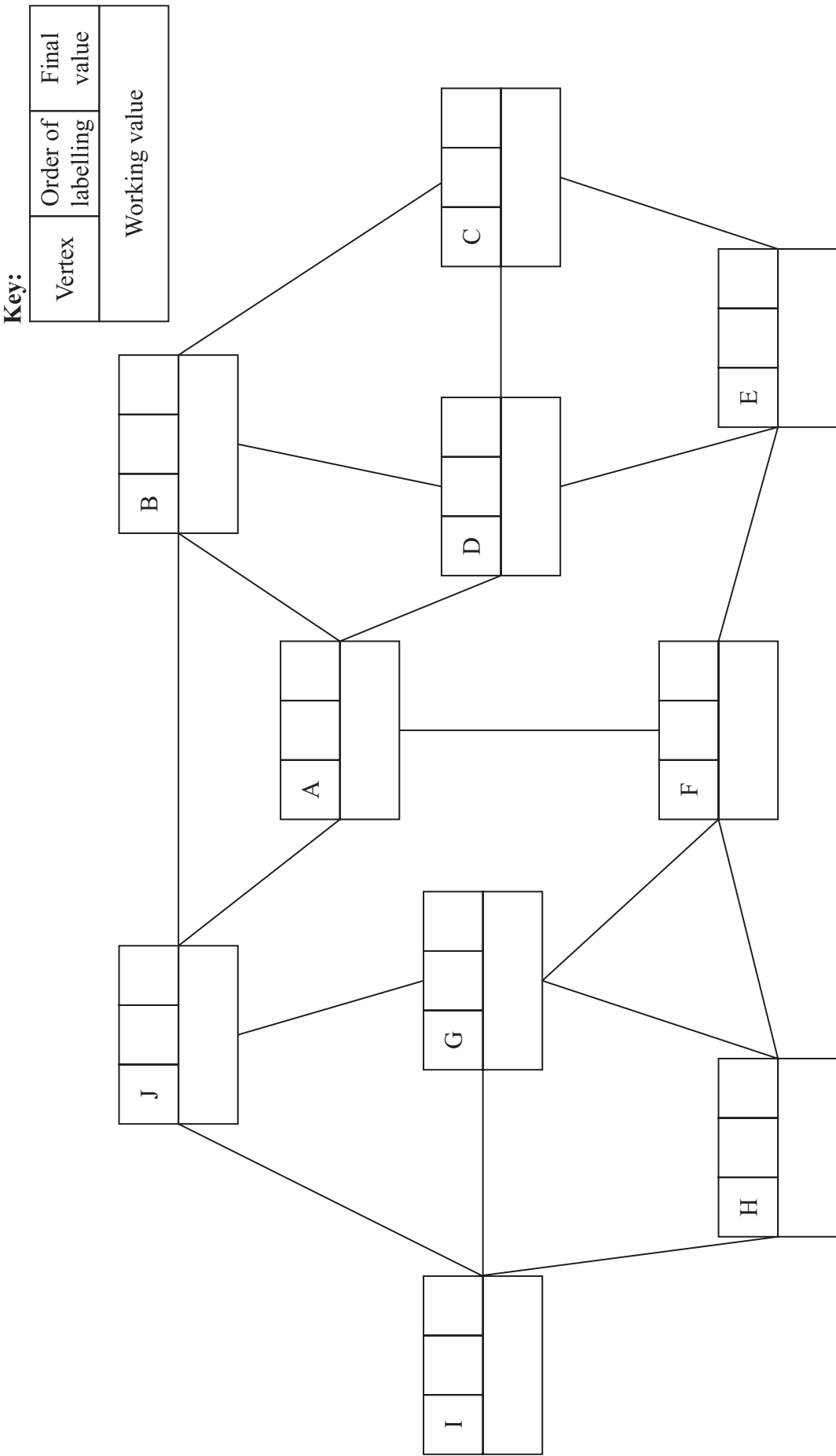
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Question 4 continued



- (b) (i) Quickest route: _____
- (ii) Length of the quickest route: _____

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(Total for Question 4 is 8 marks)

Question 5

Write the answer to Question 5 on these 2 pages

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DO NOT WRITE IN THIS AREA

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Question 5 continued

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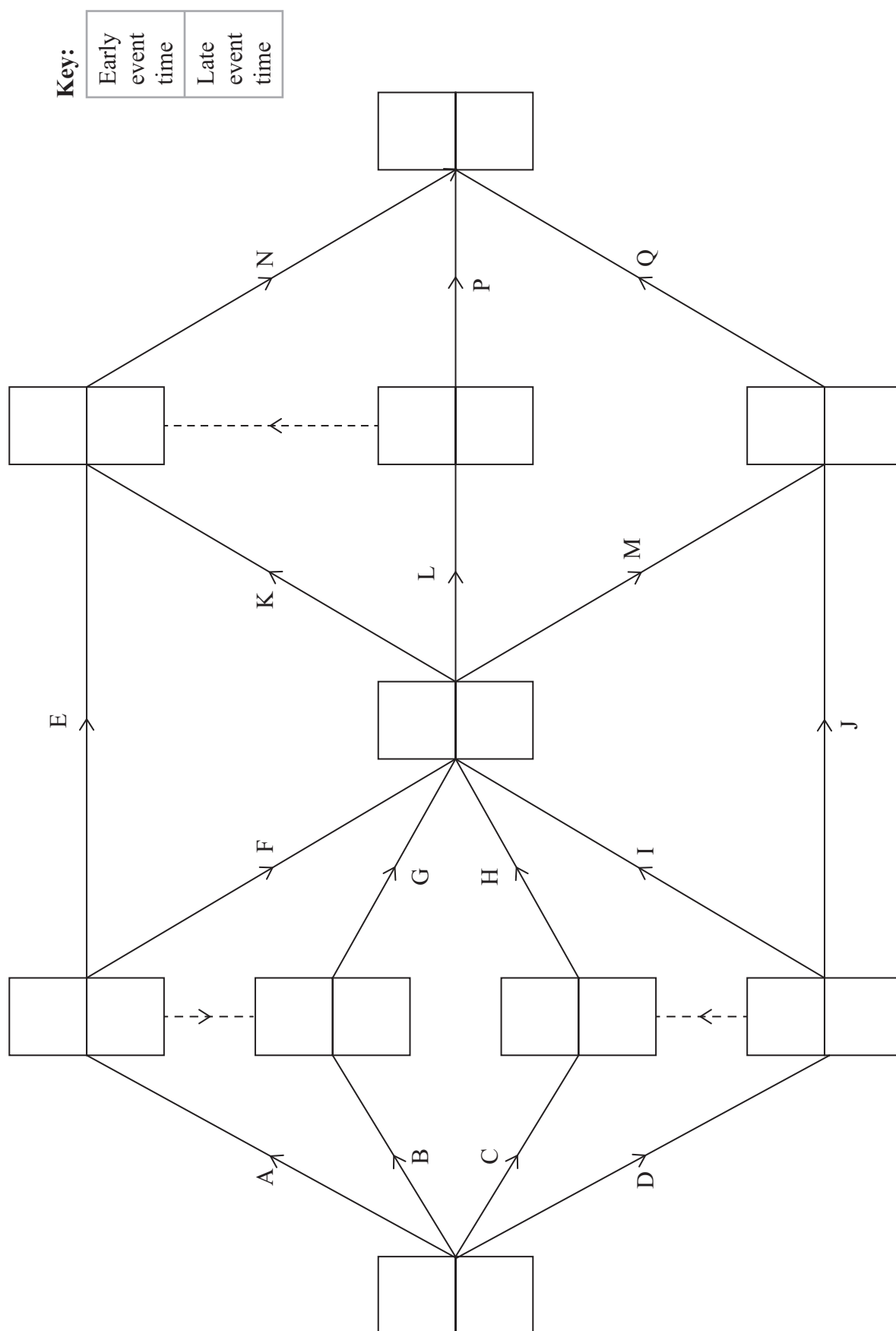
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(Total for Question 5 is 9 marks)



Question 6

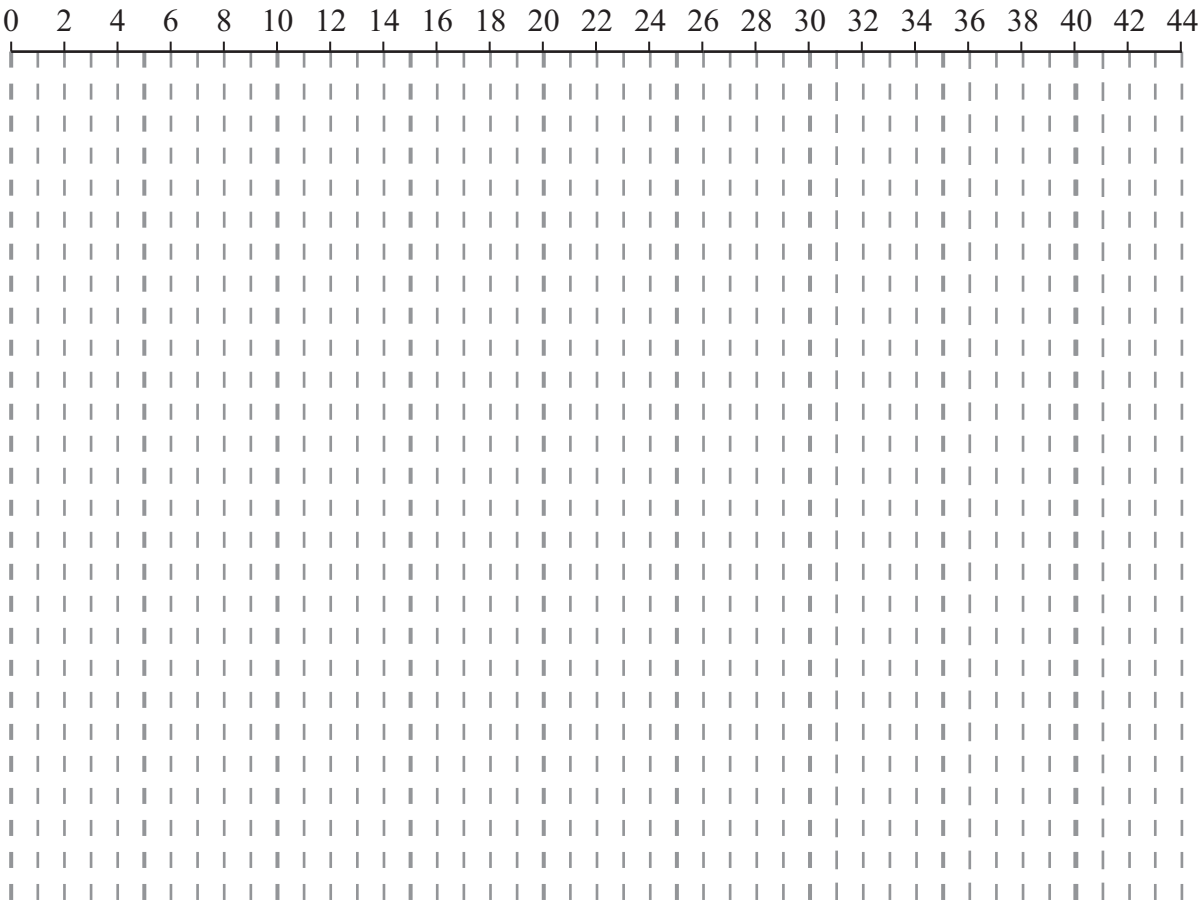
Write the answer to Question 6 on these 2 pages



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Question 6 continued

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This is the end of Question 6 answer space. Please turn the page for Question 7 answer space.

(Total for Question 6 is 12 marks)

Question 7

Write the answer to Question 7 on these 4 pages

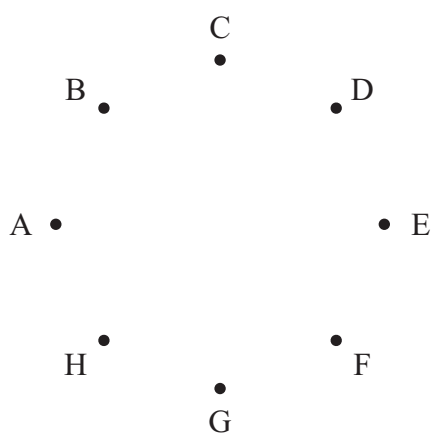
	A	B	C	D	E	F	G	H
A	–	43	38	52	44	39	57	48
B	43	–	41	39	50	46	36	43
C	38	41	–	48	53	44	51	45
D	52	39	48	–	43	52	47	49
E	44	50	53	43	–	50	42	46
F	39	46	44	52	50	–	48	54
G	57	36	51	47	42	48	–	42
H	48	43	45	49	46	54	42	–

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b)



DO NOT WRITE IN THIS AREA

Question 7 continued

	A	B	C	D	E	F	G	H
A	–	43	38	52	44	39	57	48
B	43	–	41	39	50	46	36	43
C	38	41	–	48	53	44	51	45
D	52	39	48	–	43	52	47	49
E	44	50	53	43	–	50	42	46
F	39	46	44	52	50	–	48	54
G	57	36	51	47	42	48	–	42
H	48	43	45	49	46	54	42	–

Handwriting practice lines consisting of 20 horizontal lines.

Question 7 continued

	A	B	C	D	E	F	G	H
A	–	43	38	52	44	39	57	48
B	43	–	41	39	50	46	36	43
C	38	41	–	48	53	44	51	45
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F	39	46	44	52	50	–	48	54
G	57	36	51	47	42	48	–	42
H	48	43	45	49	46	54	42	–

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DO NOT WRITE IN THIS AREA

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DO NOT WRITE IN THIS AREA

Question 7 continued

	A	B	C	D	E	F	G	H
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F	39	46	44	52	50	–	48	54
G	57	36	51	47	42	48	–	42
H	48	43	45	49	46	54	42	–

Handwriting practice lines for Question 7.

This is the end of Question 7 answer space. Please turn the page for Question 8 answer space.

(Total for Question 7 is 13 marks)

Question 8

Write the answer to Question 8 on these 5 pages

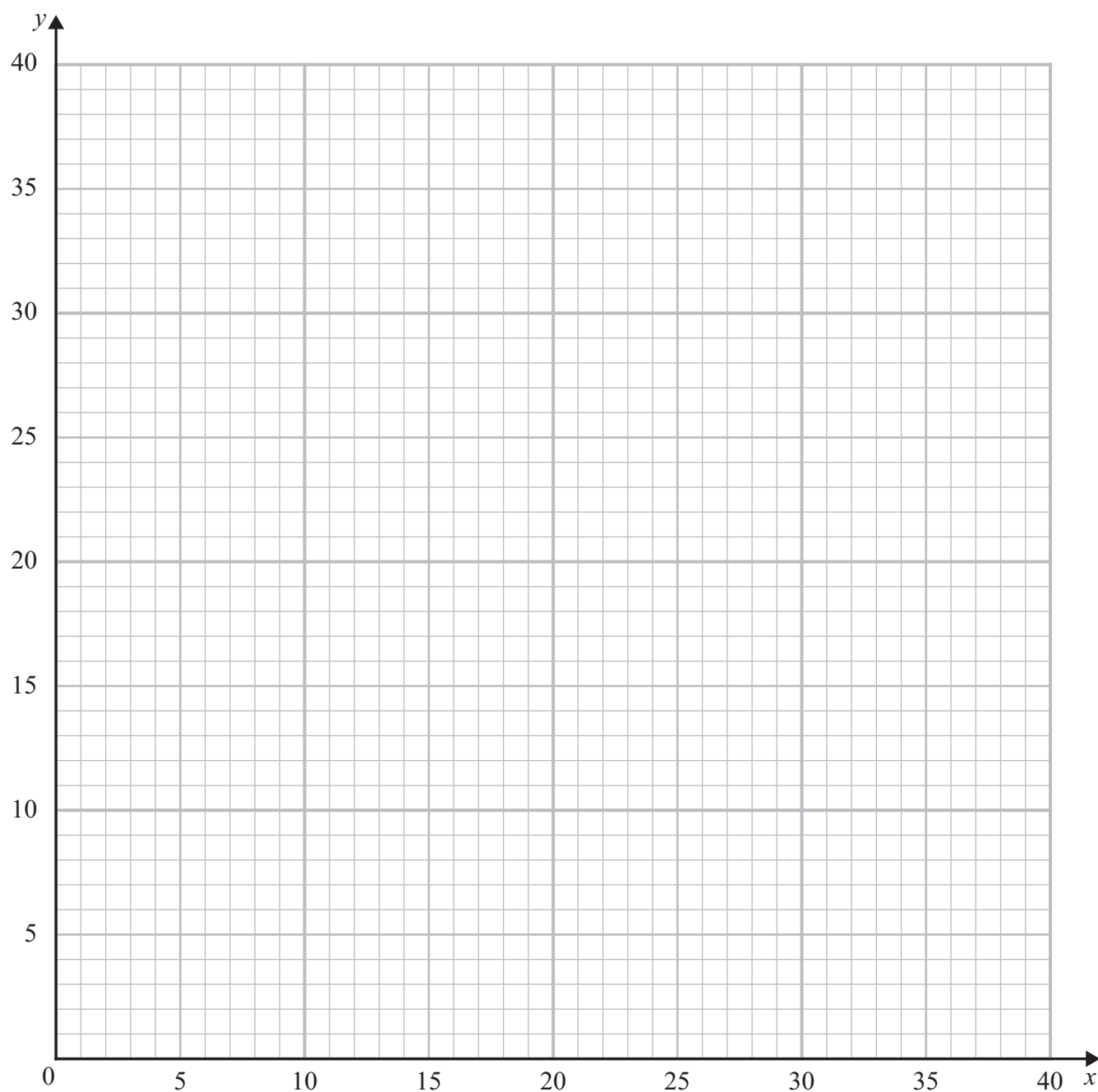
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Question 8 continued



There is a spare grid on page 24 if you need to redraw your answer to part (b).



Question 8 continued

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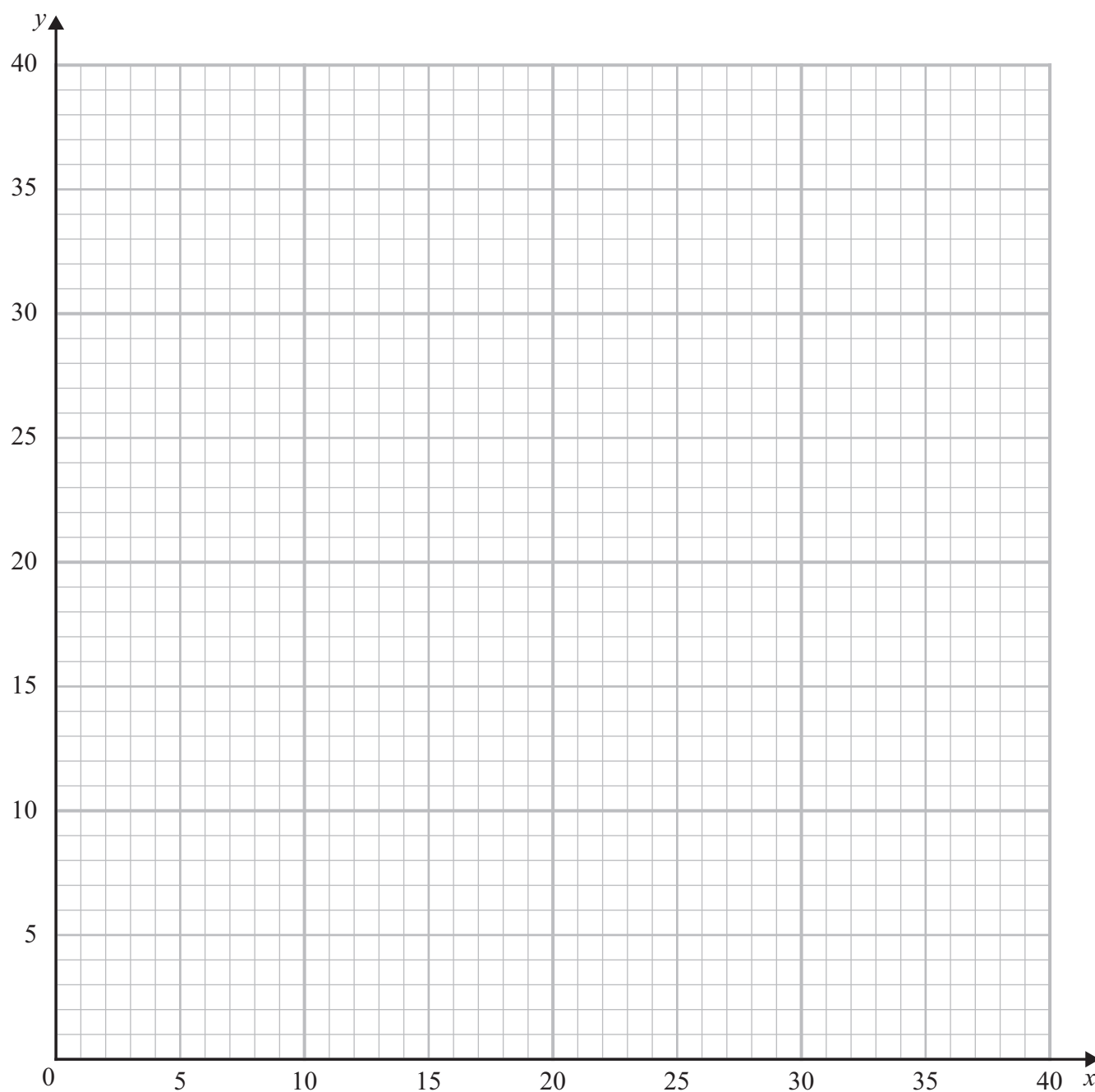
Question 8 continued

Lined area for writing the answer to Question 8.



Question 8 continued

Use this grid only if you need to redraw your answer to part (b).



(Total for Question 8 is 14 marks)

TOTAL FOR PAPER IS 75 MARKS

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