Please write clearly in block capitals.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname ____

Forename(s) ____

Candidate signature ____

AS
MATHEMATICS

Unit Decision 1

Friday 23 June 2017 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working, otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The **final** answer to questions requiring the use of calculators should be given to three significant figures, unless stated otherwise.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

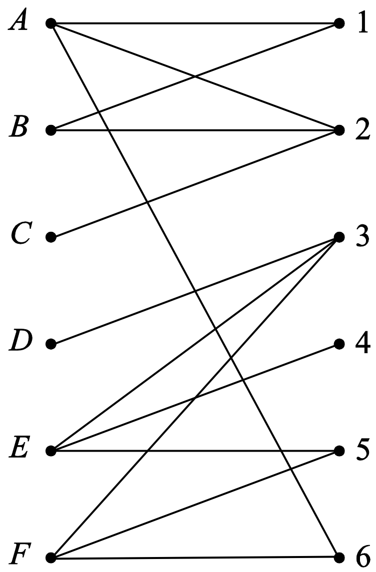
Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice
- You do not necessarily need to use all the space provided.

Answer **all** questions.

Answer each question in the space provided for that question.

1 Six players, A, B, C, D, E and F, are to be allocated to the six positions, 1, 2, 3, 4, 5 and 6, in a netball team at a tournament. The following bipartite graph shows the positions that each player is willing to play.



(a) For the first game in the tournament the coach suggests A for position 1, B for position 2, E for position 3 and F for position 5.

Show, using an alternating path algorithm from this initial matching, how each player can be selected for a position that they are willing to play.

[4 marks]

(b) For the second game in the tournament player A says she will only play position 1.

Explain fully the consequences if the coach tries to do as player A wants.

[2 marks]

QUESTION PART REFERENCE	Answer space for question 1

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QUESTION PART REFERENCE	Answer space for question 1

Turn over ►

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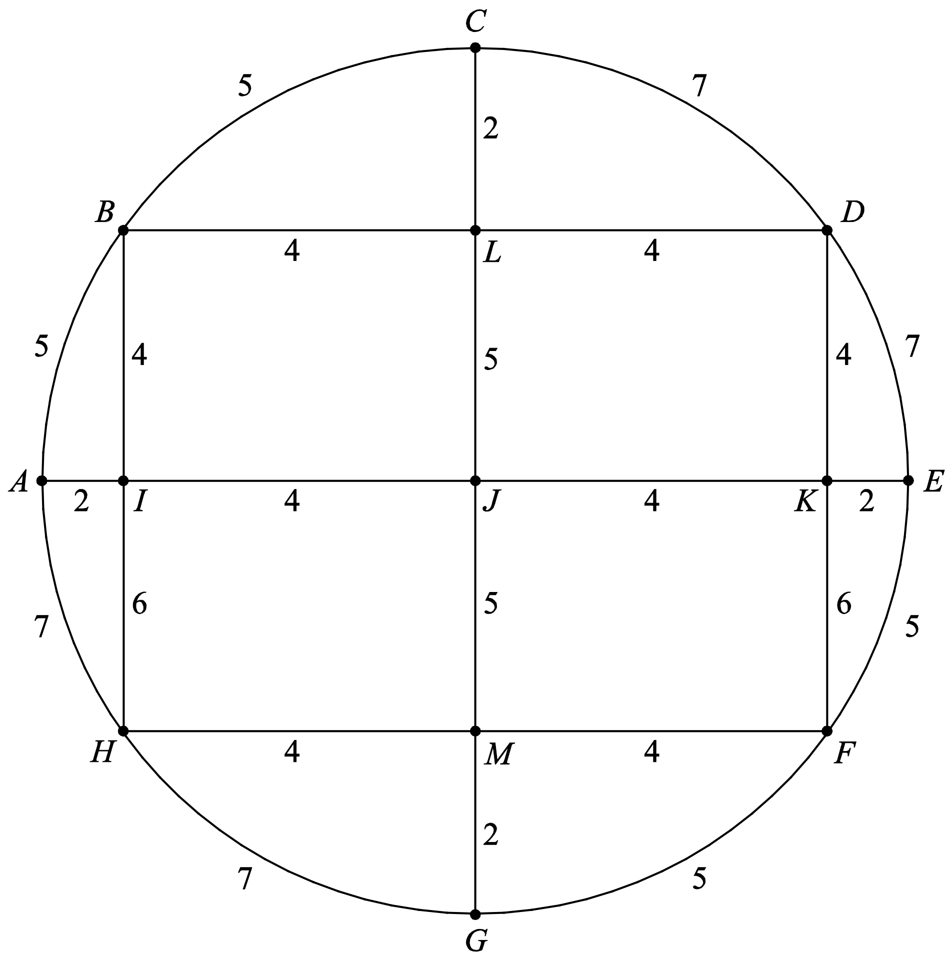
2 The diagram below shows a network representation of the paths in a garden at a stately home. The lengths of the paths are shown in metres.

The only entrance or exit to the garden is at point A.



The total length of the paths is 110 metres.

(a) Mrs Titchmarsh is a mathematics teacher and knows that an optimal Chinese postman route will be the shortest way for her to walk along every path at least once, starting and finishing at A.

Find the length of this path.

[5 marks]

(b) Mrs Titchmarsh follows this path.

State the number of times that she will pass through point B.

[1 mark]

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QUESTION PART REFERENCE	Answer space for question 2

3 (a) Use the Shell sort algorithm to rearrange the following list of numbers into ascending order.

18 3 45 17 1 26 43 22 16

[5 marks]

(b) State the number of comparisons made during the first pass.

[1 mark]

QUESTION PART REFERENCE	Answer space for question 3

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QUESTION PART REFERENCE	**Answer space for question 3**

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4 The diagram below shows a network of footpaths in a national park. The number on each edge shows the length of the footpath in kilometres.

(a) (i) Use Dijkstra's algorithm on the diagram to find the minimum footpath distance from A to H.

(ii) State the corresponding route.

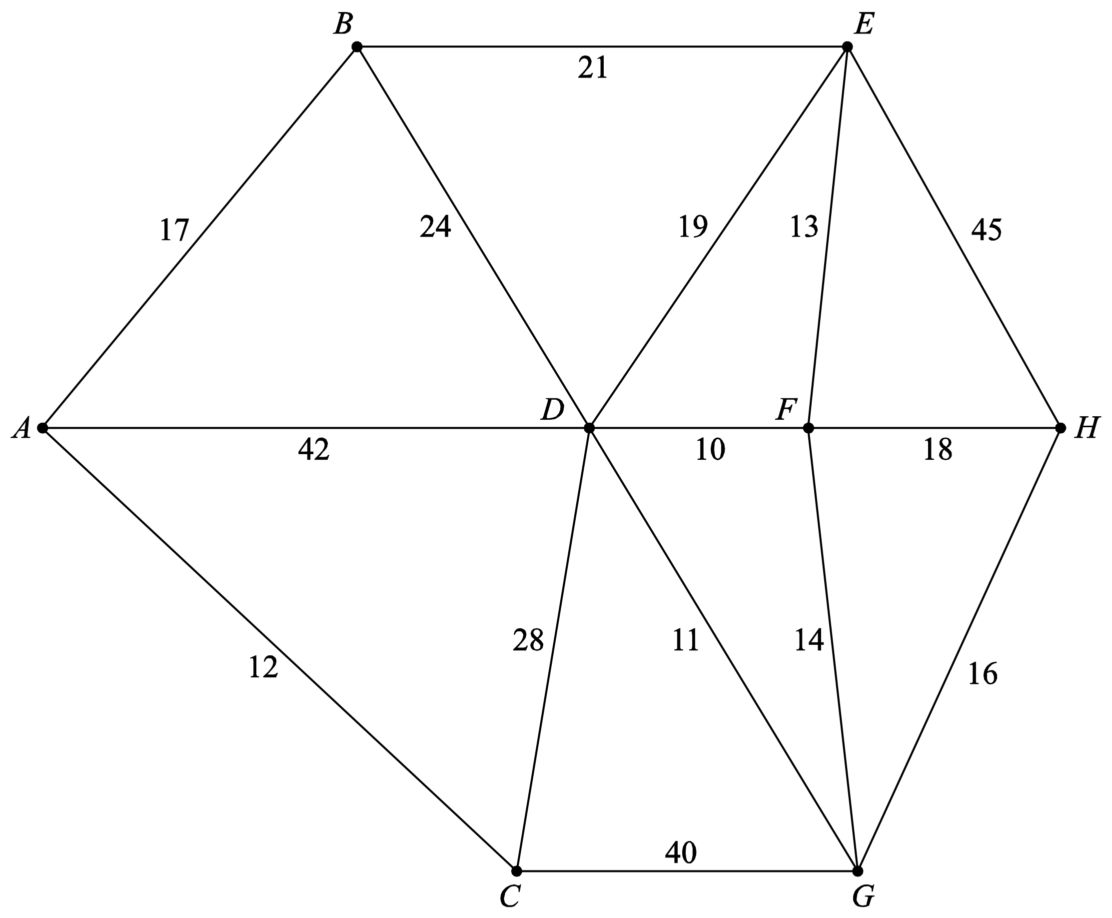
[5 marks]

(b) Location C and the footpaths connected to C are closed during the winter. Find the shortest route from A to H during this time and state its length.

[2 marks]

QUESTION PART REFERENCE

Answer space for question 4



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QUESTION PART REFERENCE

Answer space for question 4

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5 **(a)** The lengths of the edges, in centimetres, of a connected graph with 6 vertices and 9 edges are as follows:

$$3 \quad 4 \quad 4 \quad 5 \quad 5 \quad 5 \quad 8 \quad 8 \quad 9$$

Find the minimum possible length of a Hamiltonian cycle for such a graph.

[1 mark]

(b) A simple connected graph, also with 6 vertices and the same 9 edge lengths, has a minimum spanning tree of length 25 centimetres.

Draw a possible simple connected graph, labelling the edge lengths.

[3 marks]

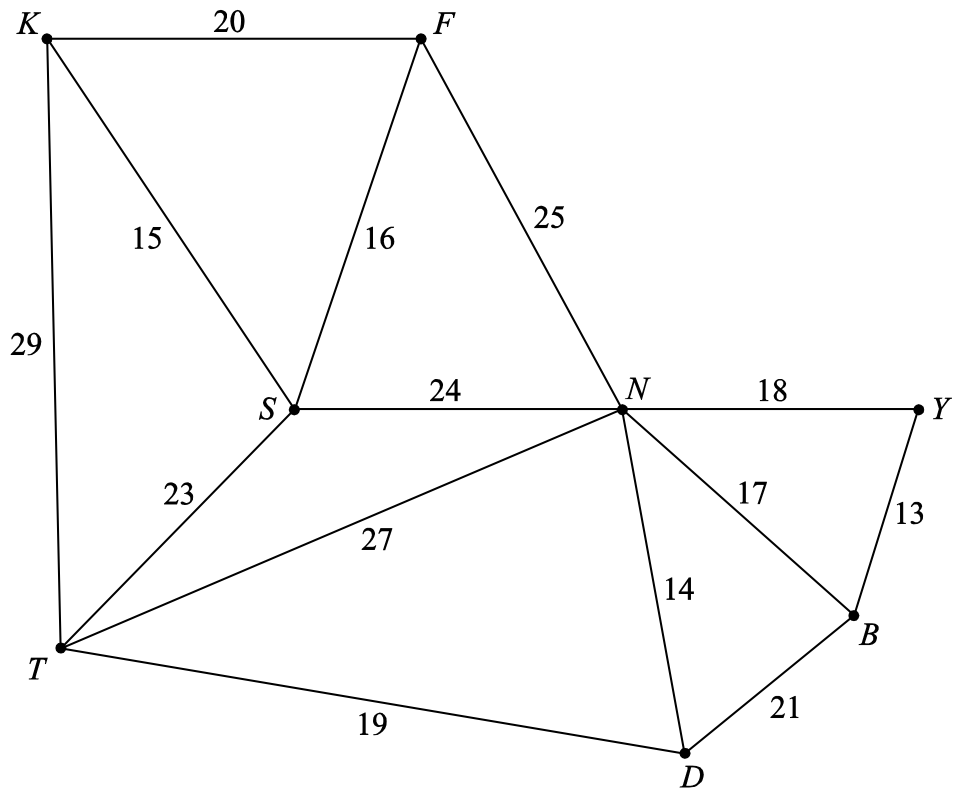
(c) Draw a simple connected Eulerian graph with 6 vertices and 9 edges.

[2 marks]

QUESTION PART REFERENCE	Answer space for question 5

QUESTION PART REFERENCE	**Answer space for question 5**

6 The network below shows the lengths, in miles, of roads connecting pairs of towns in East Anglia.



(a) (i) Use Kruskal's algorithm, showing the order in which you select the edges, to find a minimum spanning tree for the network.

(ii) Find the length of your minimum spanning tree.

(iii) Draw your minimum spanning tree.

[6 marks]

(b) State the final edge that would be added to the minimum spanning tree if Prim's algorithm is used:

(i) starting from S,

(ii) starting from T.

[2 marks]

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QUESTION PART REFERENCE	Answer space for question 6

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7 Mr Bunn the baker lives in town A. He has to make bread deliveries to four other towns B, C, D and E before finally returning to A. The deliveries can be made in any order. The following network table shows the minimum road distances, in miles, between the five towns.

	A	***B***	***C***	***D***	***E***
A	-	18	6	13	9
B	18	-	15	8	12
C	6	15	-	7	11
D	13	8	7	-	10
E	9	12	11	10	-

(a) Find the length of the tour $ADBECA$ and explain why this is an upper bound for the minimum length of the delivery round.

[2 marks]

(b) (i) Use the nearest neighbour algorithm, starting at C, to find another upper bound for the minimum length of the delivery round.

(ii) Write down a delivery round starting and finishing at A with the same length as that found in **(b)(i)**.

[4 marks]

(c) By deleting A, find a lower bound for the minimum length of the delivery round.

[4 marks]

(d) Write down the best inequality for L, the minimum length of the delivery round, that can be obtained from your answers to the previous parts of this question.

[2 marks]

QUESTION PART REFERENCE	**Answer space for question 7**

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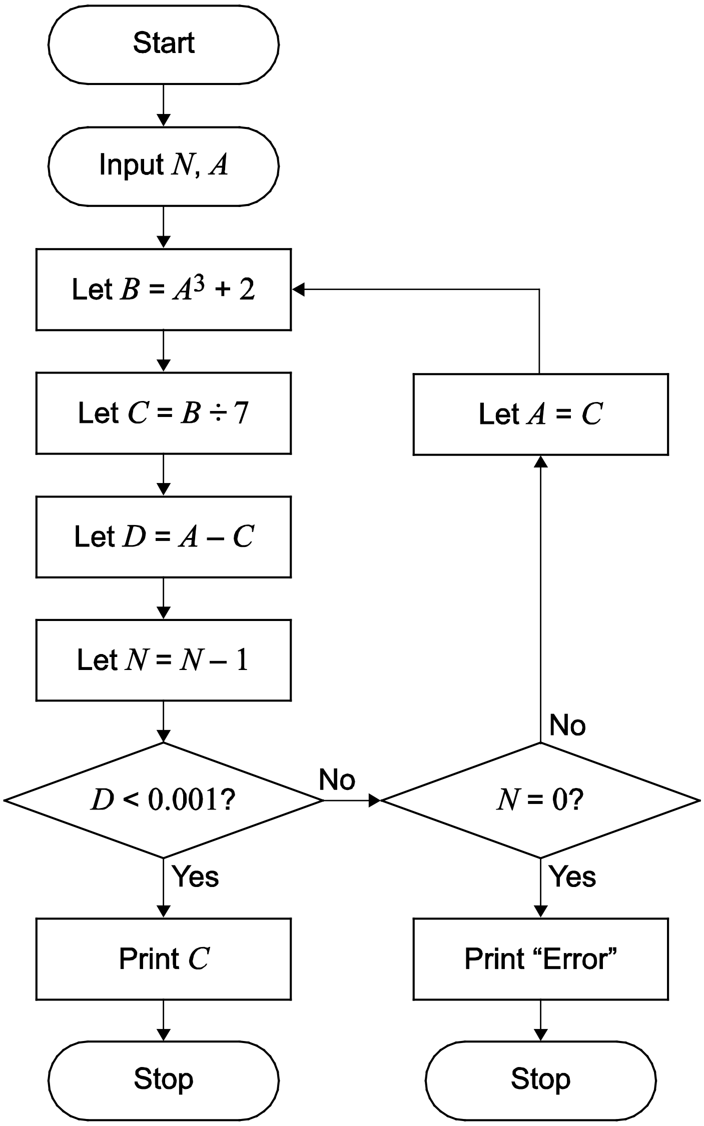
8 A student is asked to trace the following algorithm to find an approximate solution to the equation $x^3 - 7x + 2 = 0$.



(a) Trace the algorithm where the input value of N is 6 and the input value of A is 1.
Show all values of A, B, C and D correct to 4 decimal places.

[4 marks]

(b) Trace the algorithm again where the input value of N is 6 and the input value of A is 0.

[2 marks]

(c) (i) Suggest a change to one of the steps of the algorithm that would produce the same output in part **(b)** as the output in part **(a)**.

(ii) Show the effect of your suggested change to the algorithm for the input values from part **(b)**.

[3 marks]

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9 A Community Centre committee decides to buy three different types of chair – Economy, Standard and Deluxe – for use in different locations.

The committee needs at least 225 but no more than 375 chairs.

The number of Standard chairs should be at least half but no more than three times the number of Economy chairs.

The committee buys x Economy, y Standard and z Deluxe chairs.

(a) Write down four inequalities representing these constraints (in addition to $x, y, z \geqslant 0$).

[2 marks]

(b) In addition, the committee decides that 20% of the total number of chairs should be Deluxe chairs.

Show that two of your constraints in part **(a)** become

$$x + y \geqslant 180 \quad \text{and} \quad x + y \leqslant 300$$

[4 marks]

(c) On the grid on the opposite page, illustrate the four constraints and label the feasible region.

[3 marks]

(d) Economy chairs cost £10 each, Standard chairs cost £20 each and Deluxe chairs cost £40 each.

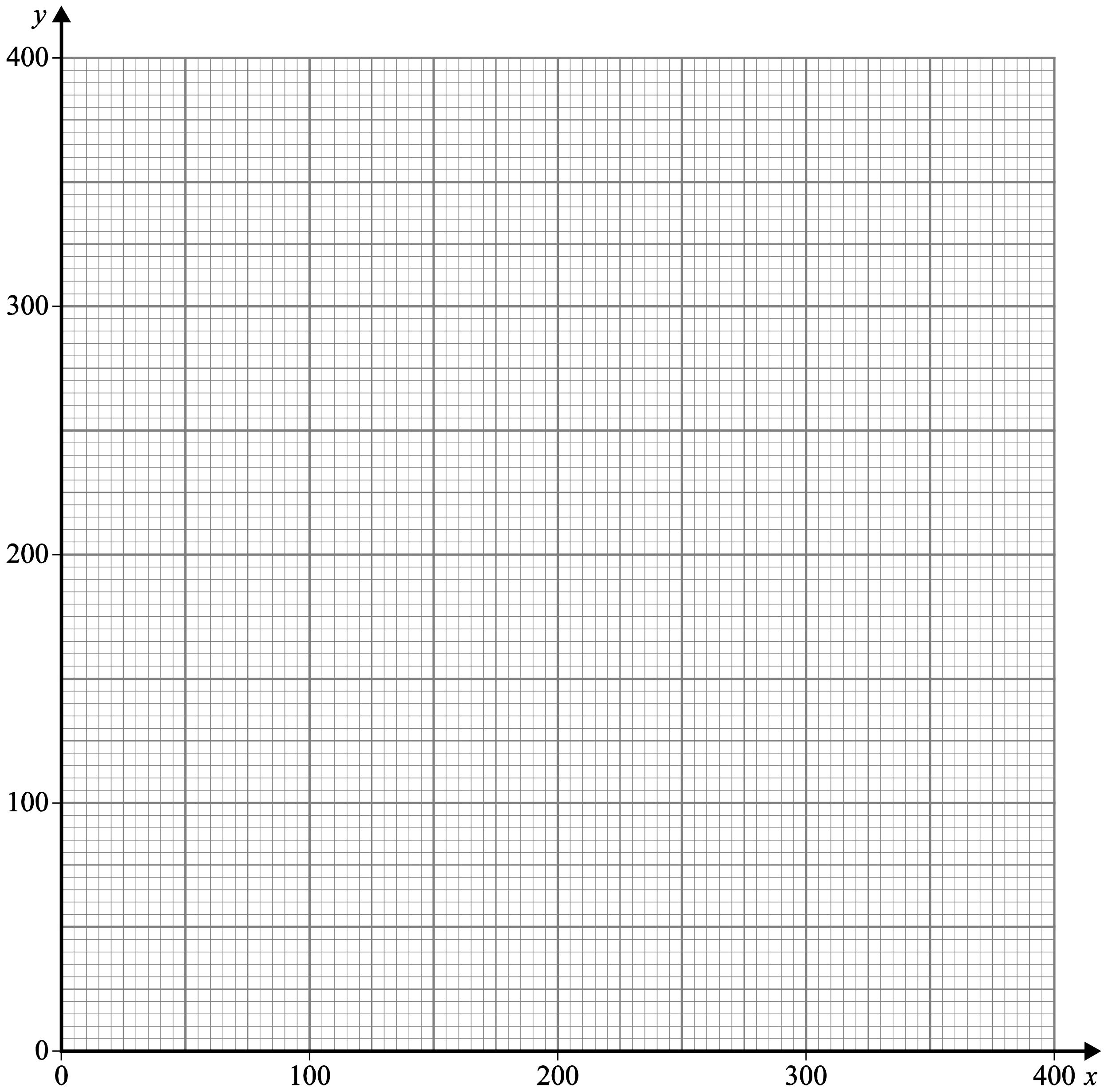
(i) Write an expression for C, the cost in £ of the total number of chairs bought, in terms of x and y only, and draw an objective line on the grid.

(ii) Use your objective line, or otherwise, to find and write down the values of x and y which give the minimum total cost. Find the minimum cost and the number of each type of chair to be purchased.

[6 marks]

QUESTION PART REFERENCE	**Answer space for question 9**

Answer space for question 9



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QUESTION PART REFERENCE	**Answer space for question 9**

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END OF QUESTIONS