

Cambridge IGCSE[™]

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

2561531814

CAMBRIDGE INTERNATIONAL MATHEMATICS

0607/52

Paper 5 Investigation (Core)

October/November 2021

1 hour 10 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer all questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do not write on any bar codes.
- You should use a graphic display calculator where appropriate.
- You may use tracing paper.
- You must show all necessary working clearly, including sketches, to gain full marks for correct methods.
- In this paper you will be awarded marks for providing full reasons, examples and steps in your working to communicate your mathematics clearly and precisely.

INFORMATION

- The total mark for this paper is 36.
- The number of marks for each question or part question is shown in brackets [].

This document has 8 pages.

This square dotty paper may be used for your diagrams.

Answer **all** the questions.

INVESTIGATION

CONNECTING DOTS

This investigation looks at the number of ways of connecting dots using straight lines.

This diagram shows 1 dot.
There is 1 row and 1 column.
This is a 1 by 1 diagram.
There are no connections to other dots.

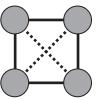


This diagram shows 4 dots. There are 2 rows and 2 columns. This is a 2 by 2 diagram.

There are 6 ways to join 2 dots.

These are:

- 2 vertical connectors (solid lines)
- 2 horizontal connectors (solid lines)
- 1 up diagonal connector (dashed line)
- 1 down diagonal connector (dashed line).

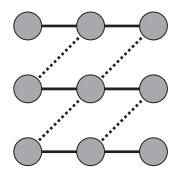


1 (a) This is a 3 by 3 diagram.

The diagram shows:

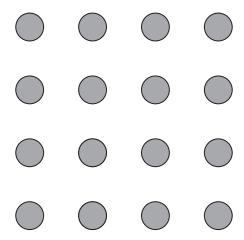
- 6 horizontal connectors
- 4 up diagonal connectors.

Each connector joins 2 dots.



Complete the diagram by drawing the 6 vertical connectors and the 4 down diagonal connectors that join 2 dots. [2]

(b) This is a 4 by 4 diagram.



On this 4 by 4 diagram,

Size of diagram (*n* by *n*)

- (i) draw the horizontal connectors and the vertical connectors that join 2 dots, [1]
- (ii) draw the up diagonal connectors and the down diagonal connectors that join 2 dots. [1]
- (c) Complete the table for the numbers of connectors that join 2 dots. Use **part** (b) and any patterns you notice.

You may use the square dotty paper on page 2 for diagrams.

Numbers of connectors that join 2 dots

		Horizontal	Vertical	Up diagonal	Down diagonal	Total
	1 by 1	0	0	0	0	0
	2 by 2	2	2	1	1	6
	3 by 3	6	6	4	4	20
L	4 by 4					
	5 by 5	20		16		
	6 by 6					110

[5]

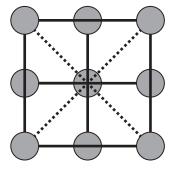
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(d)	In a	n n by n diagram there are n rows and n columns.
	(i)	Find an expression, in terms of n , for the number of up diagonal connectors that join 2 dots on an n by n diagram.
		[2]
	(ii)	Find an expression, in terms of n , for the number of horizontal connectors that join 2 dots on an n by n diagram.
		[3]
(e)		e your answers to part (d) to find the total number of connectors that join 2 dots on a 15 by 15 gram.
		[3]

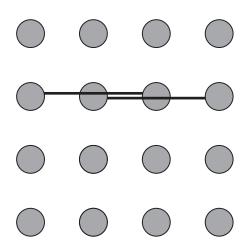
2 This is a 3 by 3 diagram.

There are 8 ways to join **3 dots**. These are:

- 3 vertical connectors
- 3 horizontal connectors
- 1 up diagonal connector
- 1 down diagonal connector.



(a) This is a 4 by 4 diagram.



Find the number of horizontal, vertical, up diagonal and down diagonal connectors that join 3 dots. Two horizontal connectors have been drawn for you.

Horizontal .	
Vertical .	
Up diagonal .	
Down diagonal .	 [2]

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(b) Complete the table for the numbers of connectors that join 3 dots. Use your answers to **part (a)** and any patterns you notice.

You may use the square dotty paper on page 2 for diagrams.

Numbers of connectors that join 3 dots

Size of diagram (*n* by *n*)

	Horizontal	Vertical	Up diagonal	Down diagonal	Total
2 by 2	0	0	0	0	0
3 by 3	3	3	1	1	8
4 by 4					
5 by 5	15				
6 by 6					80

[4]

(c) (i) This is an expression for the number of up diagonal connectors that join 3 dots on an *n* by *n* diagram.

$$(n-2)^2$$

Work out the number of up diagonal connectors that join 3 dots on a 20 by 20 diagram.

.....[1]

(ii) This is an expression for the number of horizontal connectors that join 3 dots on an n by n diagram.

$$n^2 + an$$

Find the value of a and write down the expression.

.....[3]

3 (a) Complete the table for the numbers of connectors that join 4 dots.

Numbers of connectors that join 4 dots

Size of diagram (*n* by *n*)

	Horizontal	Vertical	Up diagonal	Down diagonal	Total
3 by 3	0	0	0	0	0
4 by 4					10
5 by 5	10				
6 by 6	18	18	9	9	54

[2]

(b)	(i)	Write down an expression, in terms of n , for the number of up diagonal connectors that join
		4 dots on an <i>n</i> by <i>n</i> diagram.

.....[1]

(ii)	Find an expression, in terms of n , for the number of horizontal connectors that join 4 dots on
	an n by n diagram.

.....[2]

(c) Show that the total number of connectors that join 4 dots on an n by n diagram is

$$4n^2 - 18n + 18$$
.

[2]

(d) Find the size of the diagram which has a total of 180 connectors that join 4 dots.

.....[2]

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