



Cambridge IGCSE™

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

**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

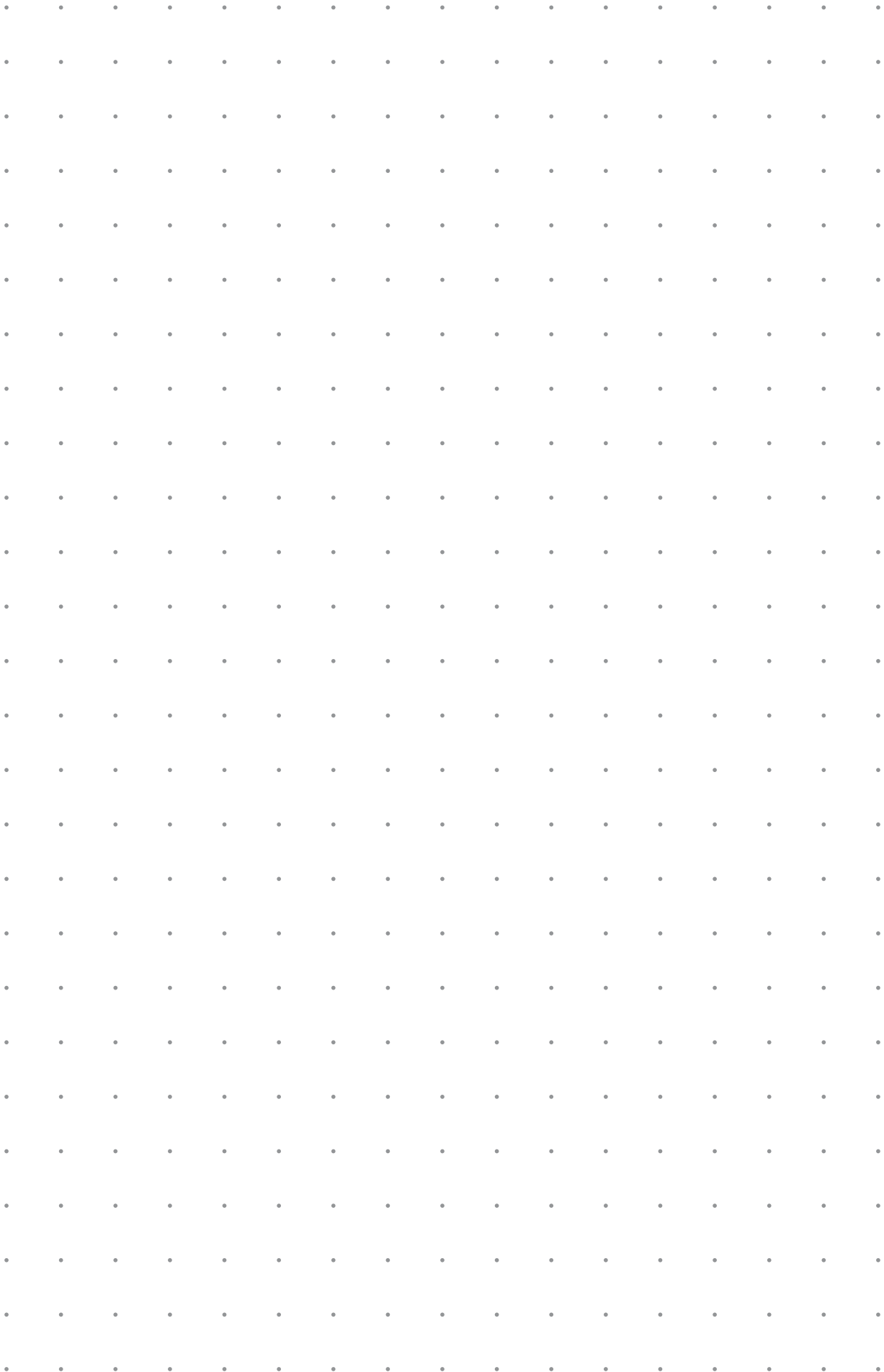
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction 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 dotted paper may be used for your diagrams.



3

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.

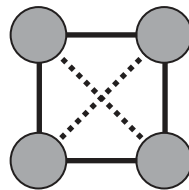
There are 2 rows and 2 columns.

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).

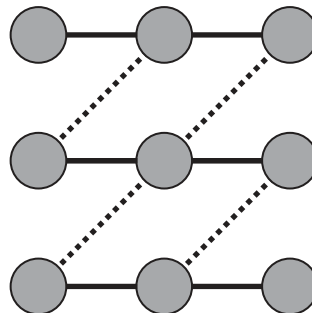


1 (a) This is a 3 by 3 diagram.

The diagram shows:

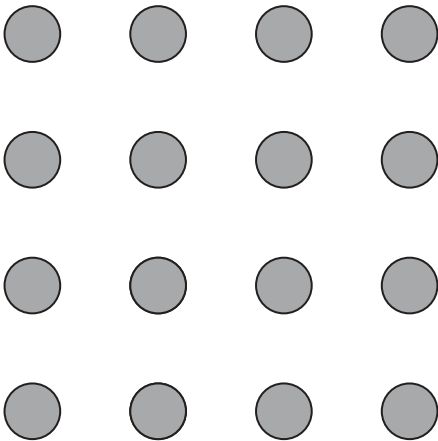
- 6 horizontal connectors
- 4 up diagonal connectors.

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,

- (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
4 by 4					
5 by 5	20		16		
6 by 6					110

[5]

5

(d) In an 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) Use your answers to **part (d)** to find the total number of connectors that join 2 dots on a 15 by 15 diagram.

..... [3]

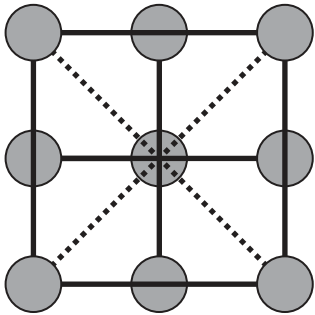
6

2 This is a 3 by 3 diagram.

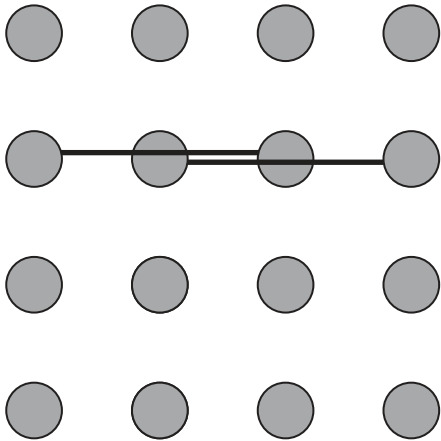
There are 8 ways to join **3 dots**.

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]

7

- (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 dotted paper on page 2 for diagrams.

Numbers of connectors that join 3 dots

	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]

Question 3 is printed on the next page.

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

Numbers of connectors that join 4 dots					
	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 n by n 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]

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.