Cambridge Assessment International Education

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2740027101

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/52**

Paper 5 Investigation (Core) **February/March 2024**

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.

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Answer **all** the questions.

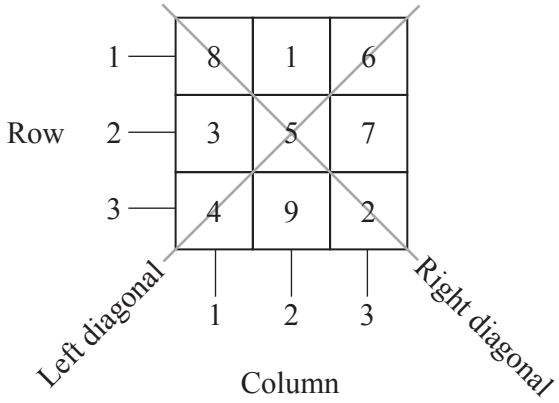
INVESTIGATION **MAGIC SQUARES**

This investigation looks at ways to make a magic square.
A magic square is a grid with a different number in each square.

The numbers in each row, each column or each diagonal all add up to the same total.
This is the *line total*.

Example

This is a 3 by 3 magic square using the integers 1 to 9.
The line total is 15.



Line totals

Row 1	$8+1+6=15$	Column 1	$8+3+4=15$	Left diagonal	$4+5+6=15$
Row 2	$3+5+7=15$	Column 2	$1+5+9=15$	Right diagonal	$8+5+2=15$
Row 3	$4+9+2=15$	Column 3	$6+7+2=15$		

1 This is part of a different 3 by 3 magic square using the integers 1 to 9.

2	9	4
7		3
	1	

(a) Work out the line total for this magic square.

..... [2]

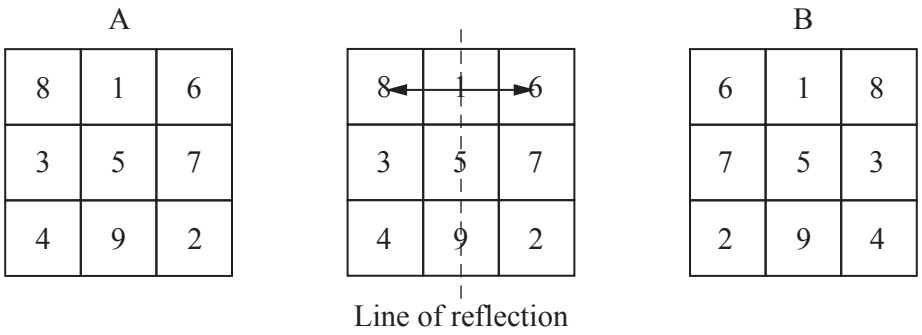
(b) Complete this magic square.

[3]

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2 A and B are two magic squares using the integers 1 to 9.
More magic squares can be made using reflection.

B is made by reflecting the position of each integer using a vertical line of reflection.
The line of reflection goes through the middle column of A.
The numbers move from the square in A to the reflected square in B.



(a) Draw a horizontal line of reflection through the middle row of magic square A.

Complete the new magic square C using the horizontal line of reflection.

C

3	5	7

[1]

(b) Two different magic squares can be made by reflection in the left and right diagonal lines drawn on A.

Complete these magic squares.

Reflection in left diagonal

		6
	5	
4		

Reflection in right diagonal

	5	

[2]

3 **(a)** **(i)** Calculate the total of the integers 1 to 9.

..... [1]

(ii) A 3 by 3 magic square uses the integers 1 to 9.

Complete the following statements to find the line total for this magic square.

The total of the integers in all three rows = ...

The line total = ... ÷ ..... = ...

[2]

(b) In all of the magic squares using the integers 1 to 9 the integer in the middle square is the same.

(i) Write down the integers 1 to 9.

..... [1]

(ii) What is the connection between the middle integer of the integers 1 to 9 and the magic square?

.....

..... [1]

(iii) Explain how to use the middle integer of the integers 1 to 9 to find the line total of a 3 by 3 magic square.

..... [1]

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4 A 3 by 3 magic square is made using the even integers from 2 to 18.

(a) (i) Find the middle integer of these integers.

..... [2]

(ii) Use your answer to **Question 3(b)(iii)** to find the line total for this magic square.

..... [1]

(iii) Use your answers to **part (i)** and **part (ii)** to help you complete the magic square below.

16		12

[2]

(b) Use your answer to **part (a)(iii)** and a reflection to make another 3 by 3 magic square.

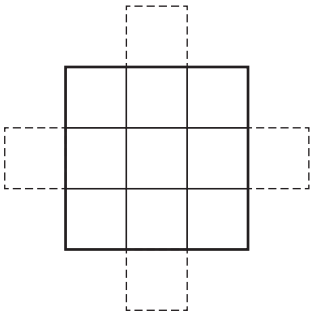
[1]

5 This is a method to make a 3 by 3 magic square.

Example
This uses the integers 1 to 9.

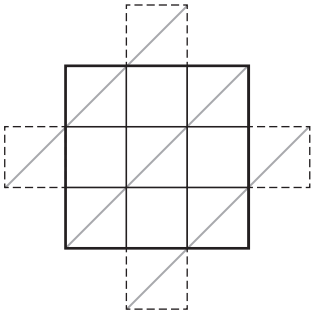
Step 1

Add one square to each edge to make a cross shape.



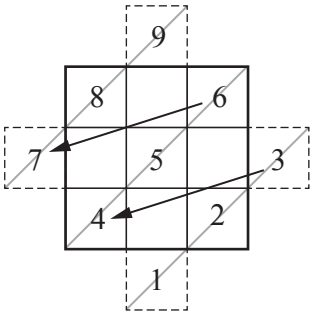
Step 2

Draw three diagonals on the grid. Each one goes through three squares.



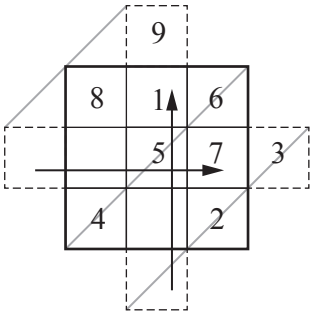
Step 3

Write the smallest integer in the bottom square.
Write the other integers along the diagonals in order, as shown.



Step 4

Move the integers from the outside squares to the empty squares inside and opposite.

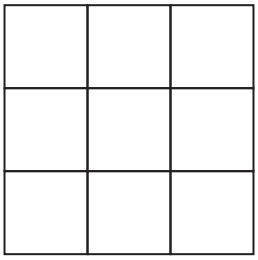


Completed magic square

8	1	6
3	5	7
4	9	2

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(a) (i) Use the method to make a 3 by 3 magic square using the integers 15 to 23.



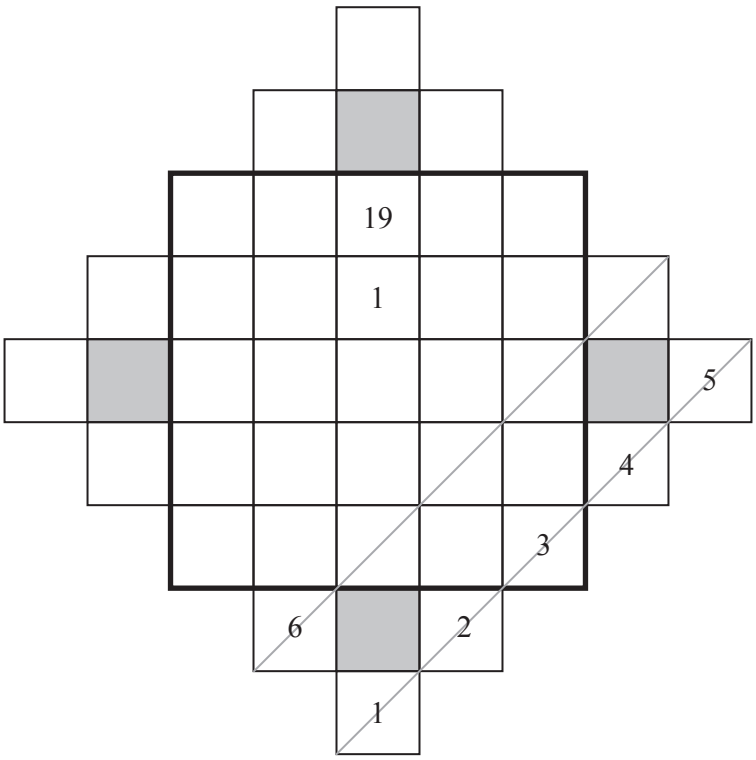
[4]

(ii) Work out the line total.

..... [1]

(b) (i) You can use a similar method to make a 5 by 5 magic square using the integers 1 to 25.
Two of the diagonals through 5 squares have been drawn.
The first six integers have been placed on the correct diagonals.

Complete the 5 by 5 magic square.
The integers 1, 3 and 19 have been put in their final positions to help you.
Do **not** put integers in the shaded squares.



[5]

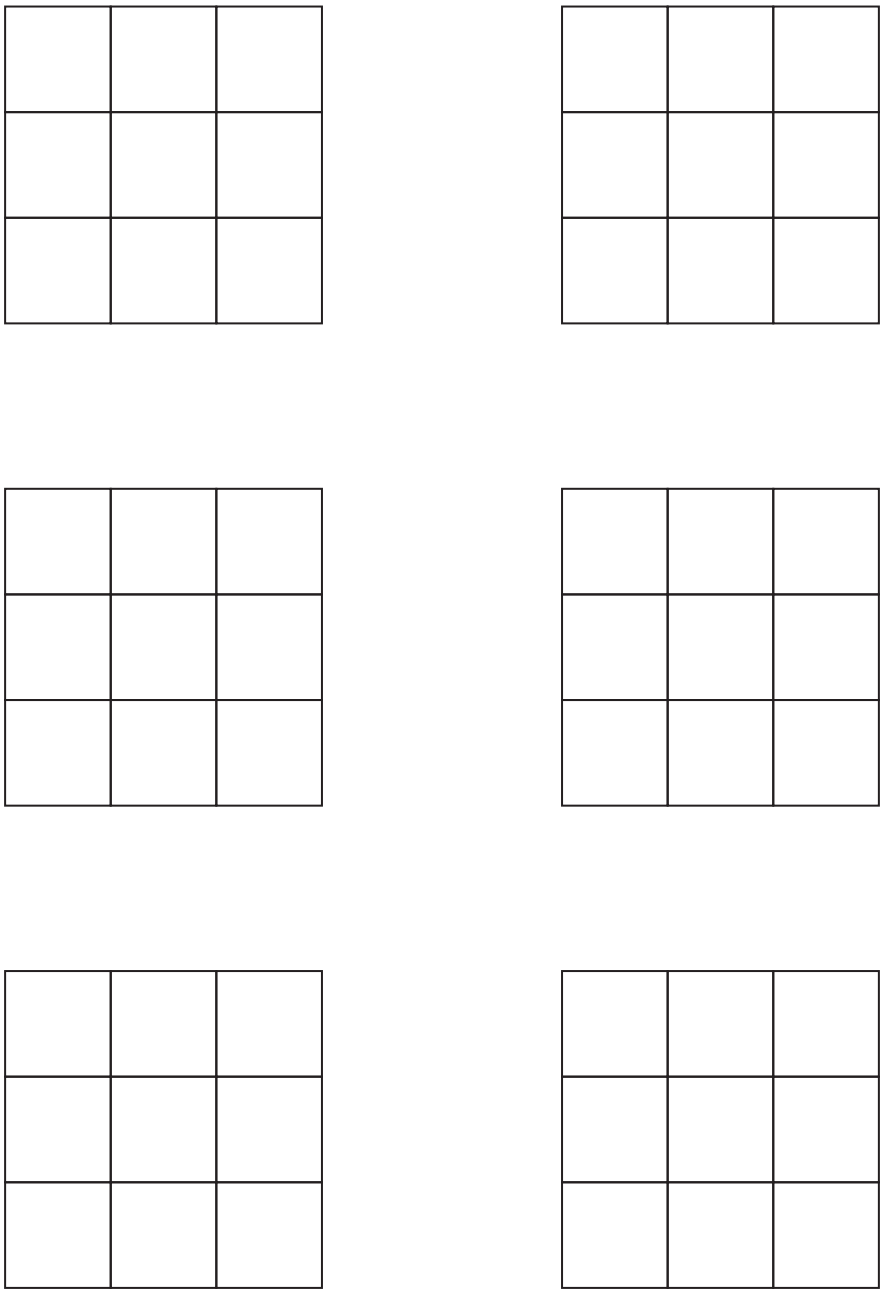
(ii) Complete this statement.

The line total is ..... = ... × middle integer. [2]

Question 6 is printed on the next page.

6 Different 3 by 3 magic squares are made using the first nine terms of a sequence.
The first term of the sequence is 2.
The nth term of the sequence is $3n - 1$.

Find four of these magic squares.
Use the method of **Question 5** and reflection to help you.



[4]

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