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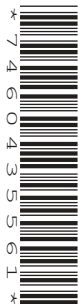
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CAMBRIDGE INTERNATIONAL MATHEMATICS

0607/51

Paper 5 Investigation (Core)

October/November 2020

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. Blank pages are indicated.

Answer **all** the questions.

INVESTIGATION

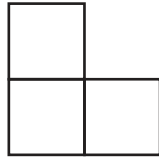
PILING SQUARES

This investigation looks at different ways of piling squares.
All the squares are the same size.

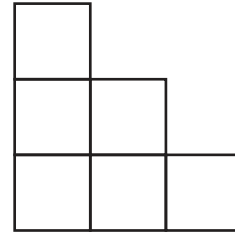
1 Squares are piled in a pattern, like this:



1 square on the bottom row
Total = 1 square



2 squares on the bottom row
Total = 3 squares



3 squares on the bottom row
Total = 6 squares

(a) On the dotted paper, complete the next two diagrams in this sequence.

A grid of 10 rows and 18 columns of dots. The first two rows are empty. The third row has four squares drawn in the first four columns. The fourth row has five squares drawn in the first five columns. The remaining rows are empty.

[2]

(b) (i) Complete the table.

Number of squares on the bottom row (s)	1	2	3	4	5	6
Total number of squares (T)	1	3	6			

[3]

(ii) When the number of squares on the bottom row is 3 the total number of squares is 6.

Use this information to explain how to calculate the total number of squares when there are 4 squares on the bottom row.

..... [1]

(c) (i) Write down the number of **extra** squares needed to change a pattern with 9 squares on the bottom row to one with 10 squares on the bottom row.

..... [1]

(ii) Calculate the **total** number of squares when there are 10 squares on the bottom row.

..... [2]

- (d) (i) A formula for finding the total number of squares, T , in terms of the number of squares on the bottom row, s , is

$$T = ks^2 + \frac{1}{2}s, \quad \text{where } k \text{ is a constant.}$$

Use the results in **part (b)(i)** to find the value of k .

..... [2]

- (ii) A pattern has 12 squares on the bottom row.
Show that your formula in **part (i)** gives the correct total number of squares.

[3]

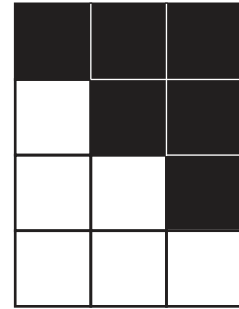
2 Black squares and white squares are now piled on top of each other like this:



1 square on the bottom row
Height = 2 squares
Total = 2 squares



2 squares on the bottom row
Height = 3 squares
Total = 6 squares



3 squares on the bottom row
Height = 4 squares
Total = 12 squares

(a) On the dotted paper, complete the next diagram in the sequence.

A grid of 17 columns and 10 rows of dots. The first four rows are empty. The fifth row contains a 1x4 grid of squares. The sixth row contains a 2x4 grid of squares. The seventh row contains a 3x4 grid of squares. The eighth row contains a 4x4 grid of squares. The ninth row contains a 5x4 grid of squares. The tenth row contains a 6x4 grid of squares.

[1]

(b) (i) Complete the table.

Number of squares on the bottom row (s)	1	2	3	4	5	6
Height (H)	2	3	4			

[1]

(ii) Write down a formula for the height, H , in terms of the number of squares on the bottom row, s .

..... [1]

(c) (i) Complete the table.

Number of squares on the bottom row (s)	1	2	3	4	5	6
Total number of squares (T)	2	6	12			

[3]

(ii) Find a formula for the total number of squares, T , in terms of the number of squares on the bottom row, s .

..... [4]

(iii) Find the total number of squares in a pattern with 15 squares on the bottom row.

..... [2]

(d) Write down a formula to calculate the number of black squares, N , in a pattern with s squares on the bottom row.

..... [1]

- (e) Calculate the number of white squares, the number of black squares and the total number of squares in a pattern with 50 squares on the bottom row.

Number of white squares =

Number of black squares =

Total number of squares = [3]

- (f) (i) A pattern of black squares and white squares has 561 black squares.
Find the number of squares in the bottom row.

..... [3]

- (ii) Is it possible to have a pattern of black squares and white squares with a total of 480 squares?
Give a reason for your answer.

..... because

..... [3]

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