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CAMBRIDGE INTERNATIONAL MATHEMATICS

0607/52

Paper 5 Investigation (Core)

May/June 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

DOTTY POLYGONS

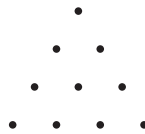
This investigation is about the number of dots in shapes that are regular polygons.

For any dotty polygon

- p is the number of sides
- n is the number of dots on one side
- there are the same number of dots on each side.

Example

This is a dotty triangle.



In this dotty triangle, $p = 3$ and $n = 4$.

- 1 (a) Look at the numbers of dots in each row of the example.

Complete this sum for the total number of dots in the dotty triangle.

$$1 + 2 + 3 + \dots = \dots [2]$$

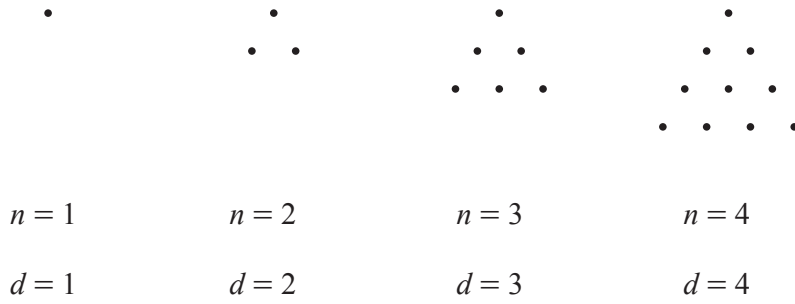
- (b) For a dotty triangle where $n = 10$, complete this sum and find the total number of dots.

$$1 + 2 + 3 + \dots + \dots + \dots + \dots + \dots + \dots + \dots = \dots [2]$$

- (c) Show that $\frac{n^2}{2} + \frac{n}{2}$ gives the correct number of dots when $n = 10$.

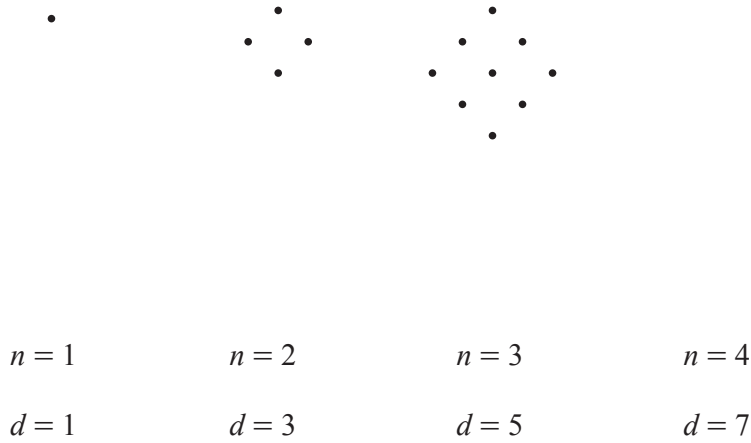
[2]

- 2 The diagram shows the first four dotted triangles.
The number of dots added each time is d .



So, for dotted triangles, $d = n$.

This diagram shows the first three dotted squares.



- (a) Draw the dotted square for $n = 4$ in the space above. [1]

- (b) (i) Write down the total number of dots in each of the first four dotted squares.
.....,,, [1]

- (ii) Write down an expression, in terms of n , for the **total** number of dots in the n th dotted square.
..... [1]

- (c) For dotted squares, find a formula for d in terms of n .
..... [3]

(d) A formula for d , in terms of p (the number of sides) and n is

$$d = (p - 2)n - p + 3.$$

By substituting appropriate values for p , show that this formula gives

(i) the formula for dotty triangles,

[2]

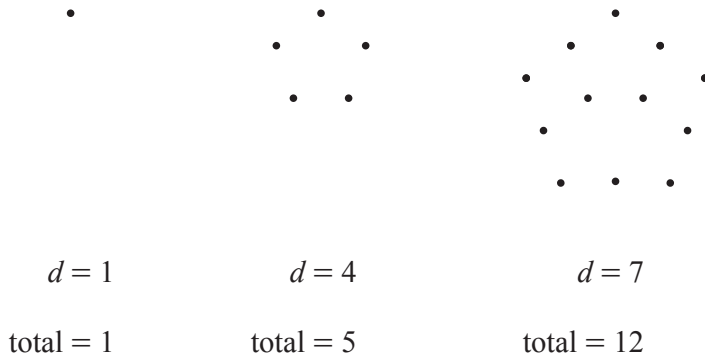
(ii) your formula for dotty squares.

[2]

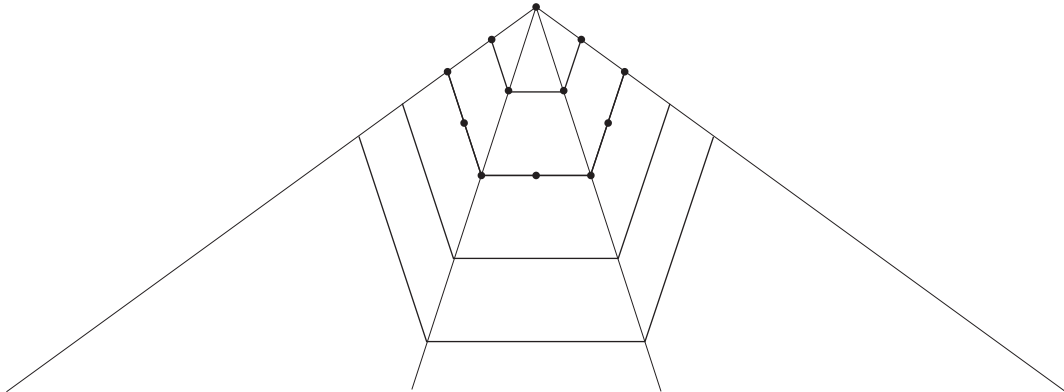
3 (a) For dotty pentagons, show that the formula in **Question 2(d)** becomes $d = 3n - 2$.

[1]

(b) This diagram shows the first three dotty pentagons.



Dotty pentagons grow along the grey lines.
 This diagram shows how to form the first three dotty pentagons.



(i) Use $d = 3n - 2$ to find the number of dots that you add to the 3rd dotty pentagon to make the 4th dotty pentagon.

..... [2]

(ii) Complete the diagram to show the 4th and 5th dotty pentagons. [2]

(iii) Complete the final statement.

$$\begin{array}{rclclcl}
 \text{1st pentagon} & + & 4 \text{ dots} & = & \text{2nd pentagon} \\
 \text{2nd pentagon} & + & 7 \text{ dots} & = & \text{3rd pentagon} \\
 & & \vdots & & \vdots \\
 \text{.....th pentagon} & + & 52 \text{ dots} & = & \text{.....th pentagon}
 \end{array}$$

[2]

4 (a) This table shows the **total** number of dots in some dotty polygons.

Use **Question 2**, **Question 3** and any patterns you notice to help you complete this table.

Polygon	p	Position of dotty polygon in its sequence					
		1st	2nd	3rd	4th	5th	n th
Triangle	3	1	3	6	10		$\frac{n^2}{2} + \frac{n}{2}$
Square	4	1	4	9			
Pentagon	5	1	5	12			
Hexagon	6	1	6				

[8]

(b)

The number of dots in a
dotty pentagon $\times 3$ = The number of dots in a
dotty triangle

(i) Give two examples from the table that show this statement is true.

[2]

(ii)

The number of dots in the 4th
dotty pentagon $\times 3$ = The number of dots in the k th
dotty triangle

Find the value of k .

..... [3]

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