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0607/52

October/November 2016

1 hour

Additional Materials: Graphics Calculator

DO **NOT** WRITE IN ANY BARCODES.

The total number of marks for this paper is 24.

This document consists of **7** printed pages and **1** blank page.

Answer **all** the questions.

INVESTIGATION

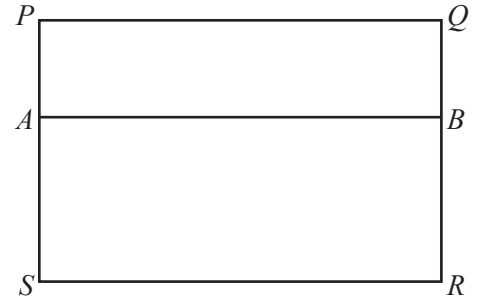
RECTANGLES WITHIN RECTANGLES

This investigation looks for a method to find the number of rectangles when you draw horizontal and vertical lines inside a rectangle.

One horizontal line, AB , is drawn inside a rectangle $PQRS$.

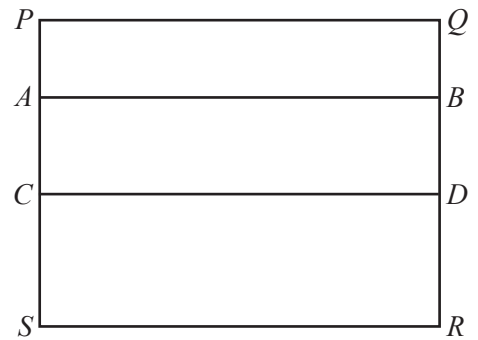
The total number of rectangles is 3.

They are $PQBA$, $PQRS$ and $ABRS$.



1 (a) Another line CD is drawn inside the rectangle $PQRS$.

The total number of rectangles is now 6.

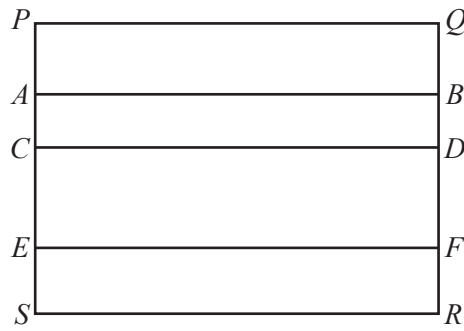


Four of the 6 rectangles are $PQBA$, $PQDC$, $PQRS$ and $ABDC$.

Complete the table to show the other two rectangles.

$PQBA$	$PQDC$	$PQRS$
$ABDC$		

- (b) Three horizontal lines, AB , CD and EF are drawn inside the rectangle $PQRS$.



Complete the table to show all ten rectangles.

$PQBA$			$PQRS$
$ABDC$		$ABRS$	
	$CDRS$		

- (c) Four horizontal lines are drawn inside the rectangle.

Find the total number of rectangles.



(d) Complete the table.

Number of horizontal lines inside the rectangle	0	1	2	3	4	5	6	7
Total number of rectangles		3	6	10				36

(e) The numbers in the bottom row of the table in **part (d)** form a sequence.

Write down the mathematical name of these numbers.

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(f) Ten horizontal lines are drawn inside the rectangle.

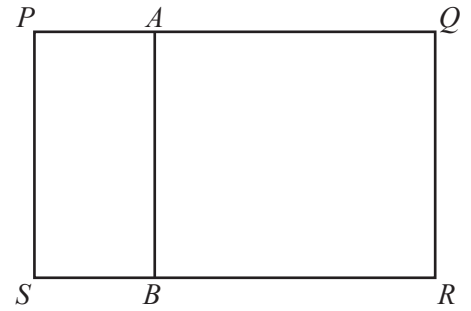
Find the total number of rectangles.

.....

- 2 One vertical line, AB , is drawn inside rectangle $PQRS$.

The total number of rectangles is 3.

They are $PABS$, $PQRS$ and $AQRB$.



- (a) Two vertical lines are drawn inside a rectangle.

Find the total number of rectangles.

.....

- (b) Complete the table.

Number of vertical lines inside a rectangle	0	1	2	3	4	5	6	7
Total number of rectangles		3						

- (c) What is the connection between the table in **question 1(d)** and the table in **question 2(b)**?

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- 3 12 vertical lines are drawn inside a rectangle.

Show that the total number of rectangles is given by the calculation $\frac{12^2 + 3 \times 12 + 2}{2}$.

- 4 (a) When n vertical lines are drawn inside a rectangle the total number of rectangles, T , is

$$T = \frac{1}{2}n^2 + an + b, \quad \text{where } a \text{ and } b \text{ are constants.}$$

Find the value of a and the value of b .

Use your answers to write down the formula for T .

$$a = \dots\dots\dots$$

$$b = \dots\dots\dots$$

$$T = \dots\dots\dots$$

- (b) Use your formula in **part (a)** to show that when 7 vertical lines are drawn inside a rectangle, the number of rectangles is 36.

- (c) Calculate how many vertical lines are drawn when there are 231 rectangles.

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- 5 When 30 horizontal lines are drawn inside a rectangle, find the total number of rectangles.

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