Exploring a Dot Grid Through Rectangles

Introduction

You have calculated areas and perimeters of figures like rectangles, triangles, maybe even circles many times. Have you ever wondered what the relationship between area and perimeter of a figure is? What happens when area increases? Does the perimeter increase or decrease? What happens to the area if the perimeter decreases?

Here we will explore the relationship between area and perimeter of rectangles. We will do this however with an important constraint – the rectangles will be those that can be drawn on a dot grid such that the corners (vertices) of the rectangles are grid points.

Materials/Facilities Required

Grid papers (Each student will require 3 to 4 square dotted grid papers), Pencils.

Look at the grid paper you have.

Let us call the length of the line segment AB (shown in *Figure 1*) as 1 unit of length.

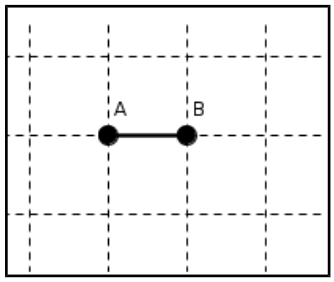

Figure 1

Now considering the above length as 1 unit then what can you say about the area of this shapes in Figure 2? Why do you think so? Discuss with your friends.

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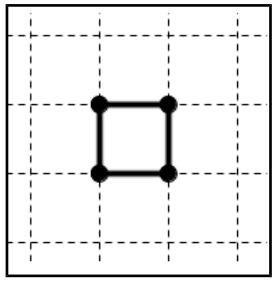


Figure 2

Task 1

Draw a few more (at least two) figures such that their areas are also 1 square unit.

Task 2

The polygons drawn in *Figure 3* are called rectilinear polygons.
Draw 5 such figures find their areas and perimeter.
Remember that all the vertices of these figures should be grid points.
* A rectilinear polygon is a polygon all of whose angles are either 90° or 270°. Some examples of rectilinear shapes are given here.

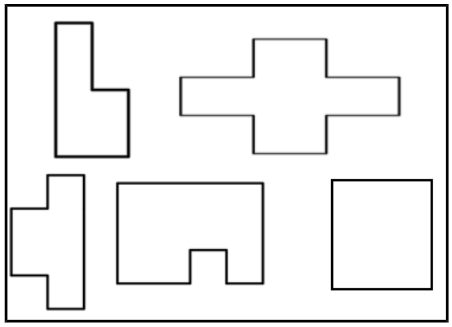


Figure 3

Task 3: Find the Areas of the Given Figures.

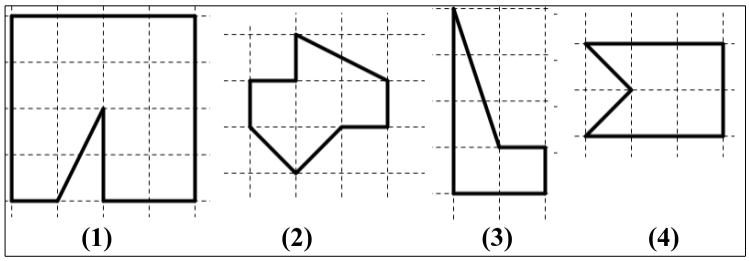


Figure 4

Task 4: Draw 5 Rectangles on the Grid Paper.

Keep in mind the following:
1) The vertices of the rectangles should be grid points.
2) Your rectangles should be of different sizes.
3) At least one of the rectangles should be tilted.
4) Measure and write the area and the perimeter of the rectangles which are not tilted. Discuss how you got your answers.

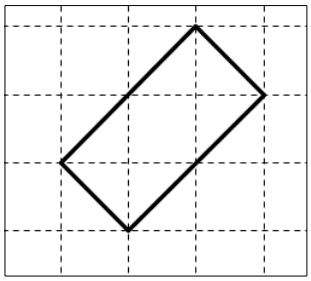
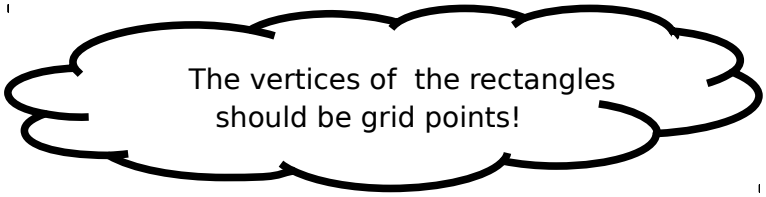


Figure 5: Tilted rectangle



Task 5

Sub Task I

1) Make different rectangles on your dot grid all of which have a perimeter of 16 units. (Draw as many you can.)
2) Complete the table given below based on your rectangles.
3) Which rectangle has the highest area? Which rectangle has the smallest area?
4) Compare your table with your friend's.
5) Did you get a square in your table? Is a square also a rectangle? _____

Perimeter is 18 units				
Rectangle	Length	Breadth	Semi-perimeter	PerimeterArea
i				
ii				
iii				
iv				
v				
vi				
vii				
viii				

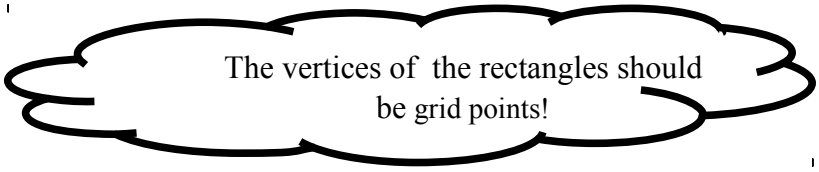
Note: "Semi-perimeter" of the rectangle is half of the perimeter.

Sub Task II

1) Make different rectangles on your dot grid all of which have a perimeter of 18 units. (Draw as many you can.)

2) Complete the table given below based on your rectangles.
3) Which rectangle has the highest area? Which rectangle has the smallest area?
4) Compare your table with your friend's.
5) Did you get a square in your table?

Perimeter is 18 units				
Rectangle	Length	Breadth	Semi-perimeter	PerimeterArea
i				
ii				
iii				
iv				
v				
vi				
vii				
viii				
ix				



Task 6

Sub Task I

1) Make different rectangles which have an area of 36 square units. (Draw as many as you can)
2) Fill this table.
3) Did you get a square?
4) Compare your table with your friend's.

Area is 36 square units				
Rectangle	Length	Breadth	Area	Perimeter
i				
ii				
iii				
iv				
v				
vi				
vii				
viii				
ix				

Sub Task II

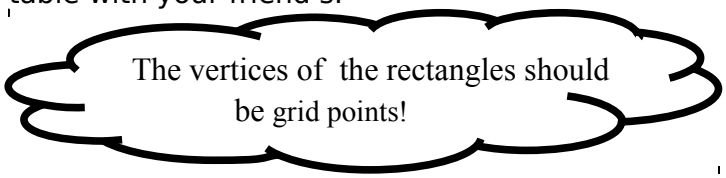
1) Make different rectangles which have an area of 17 square units. (Draw as many as you

can)
2) Fill this table.
3) Do you see any congruent rectangles among the rectangle you have drawn?
4) Compare your table with your friend's.

Area is 17 square units				
Rectangle	Length	Breadth	Area	Perimeter
i				
ii				
iii				
iv				
v				

Sub Task III

1) Make different rectangles having an area of 24 square units. (Draw as many as you can)
2) Fill this table.
3) Do you see any congruent rectangles among the rectangle you have drawn?
4) Compare your table with your friend's.



Area is 24 square units				
Rectangle	Length	Breadth	Area	Perimeter
i				
ii				
iii				
iv				
v				
vi				
vii				
viii				
ix				

Task 7

Can you draw two different rectangles whose perimeter is 14 units and area is 12 area units? How many different rectangles did you get? Compare your rectangle with your friends' rectangles. Are they the same?

Did you get different rectangles? If yes, share your answer with your friends and your teacher. If you think that is not possible then think about why not?

Task 8

Remember that all the vertices of all the figures you draw should be grid points.

Use the grid paper and explore and find answers to the following:

1) If the length and the breadth of a rectangle are natural numbers and its area is an odd number, what can you say about that rectangle's semi-perimeter (half of the perimeter)?

_____

2) If the length and the breadth of a rectangle are natural numbers and its semi-perimeter is an odd number, what can you say about the area of this rectangle?

_____

3) What are the different possible areas of triangles drawn on the grid? Are all multiples of half achieved?

_____

4) What are the possible areas of grid squares(squares with vertices on the grid)? (These may not have integer sides!)

_____

5) What are the possible areas of tilted rectangles (rectangles with vertices on the grid)? (Hint: *Look at tilted squares first*)

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References

- De, P, Sircar, S, Titus, S (2017): *LFHC - Area, Perimeter and Congruency (APC*), At Right Angles-November 2017, Azim Premji Foundation
- Ma, L. (1999). Exploring New Knowledge: The Relationship Between Perimeter And Area. In *Knowing and teaching elementary mathematics: teachers' understanding of fundamental mathematics in China and the United States*. Mahwah, N.J.: Lawrence Erlbaum Associates.

