AREA

Chapter 7

Whose field is bigger?

The map below shows the agricultural fields owned by Shakoor, Parasu and Gayadeen.

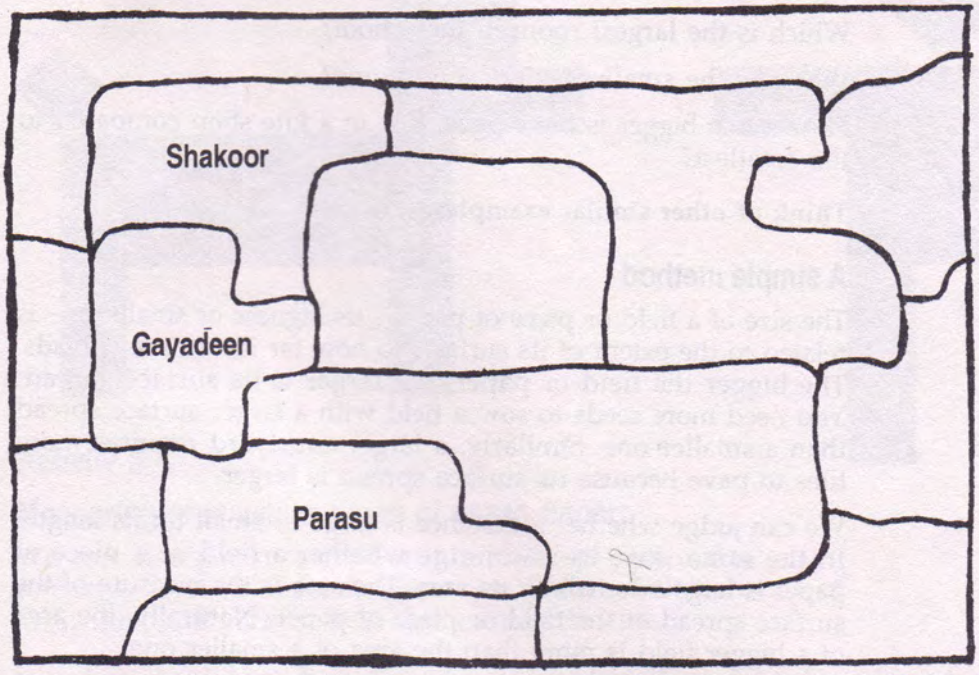


Figure 1

Can you tell by looking at the map who has the largest field - Shakoor, Parasu or Gayadeen? (1)

It's not easy answering that question just by looking at the map. So how do you find out whose field is the biggest? There is a simple method for doing this. But before discussing the method let us do the following activity.

Activity 1

Which piece is bigger

Your kit copy has a page with a square and a rectangle drawn on it. Cut them out and compare the two shapes.

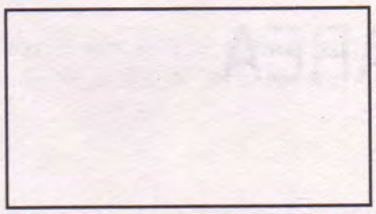


Figure 2

Which shape is longer? (2)

Which is broader? (3)

Which shape is larger? Take a guess. Can you judge which shape is larger by measuring only its length or breadth? (5)

Can you think of a method to find out which shape is larger? (6)

We often need to make such comparisons. For example, we may have to find out:

Which is the largest room in the school?

Which is the smallest window at home?

How much bigger is the biggest kite in a kite shop compared to the smallest?

Think of other similar examples. (7)

A simple method

The size of a field or piece of paper - its bigness or smallness - is related to the extent of its surface, to how far its surface spreads. The bigger the field or paper, the larger is its surface spread. You need more seeds to sow a field with a larger surface spread than a smaller one. Similarly, a larger courtyard requires more tiles to pave because its surface spread is larger.

We can judge whether a distance is large or small by its length. In the same way, we can judge whether a field or a piece of paper is large or small by its area. The area is the measure of the surface spread of the field or piece of paper. Naturally, the area of a bigger field is more than the area of a smaller one.

Let us see how area is measured. To measure length we choose a unit of measurement, such as a metre, centimetre, millimetre, etc. We then find out how many of these units, the length in question is equal to. For example, if the length is 12 cm, it means that it is equal to 12 units of 1 cm each.

Similarly, to measure area, we choose a fixed surface spread as the unit of measurement. For example, this unit could equal a square with sides which are 1 cm long. The area of such a square is 1 square centimetre. So the unit of area in this case is one square centimetre. A square centimetre is also written as 1 centimetre^2 (or 1 cm^2).

Your science kit contains a plastic cube. Each face of this cube is 1 cm^2. Cover the surface, the area of which you want to measure,

with these cubes and see how many cube faces this surface is equal to. The area of the surface is that many square centimetres.

Now find out the area of Shakoor's, Parasu's and Gayadeen's fields in cm^2. (8)

Whose field is the biggest and whose is the smallest? (9)

What are the areas of the two shapes in Activity 1? (10)

Did you guess correctly which piece was bigger? (11)

Activity 2

Measuring area:

Figure 3 shows the pictures of a man and a dog. Measure their areas with the help of the faces of the unit cubes.

Note these measurements in your exercise book. Don't forget to write the unit of measurement. (12)

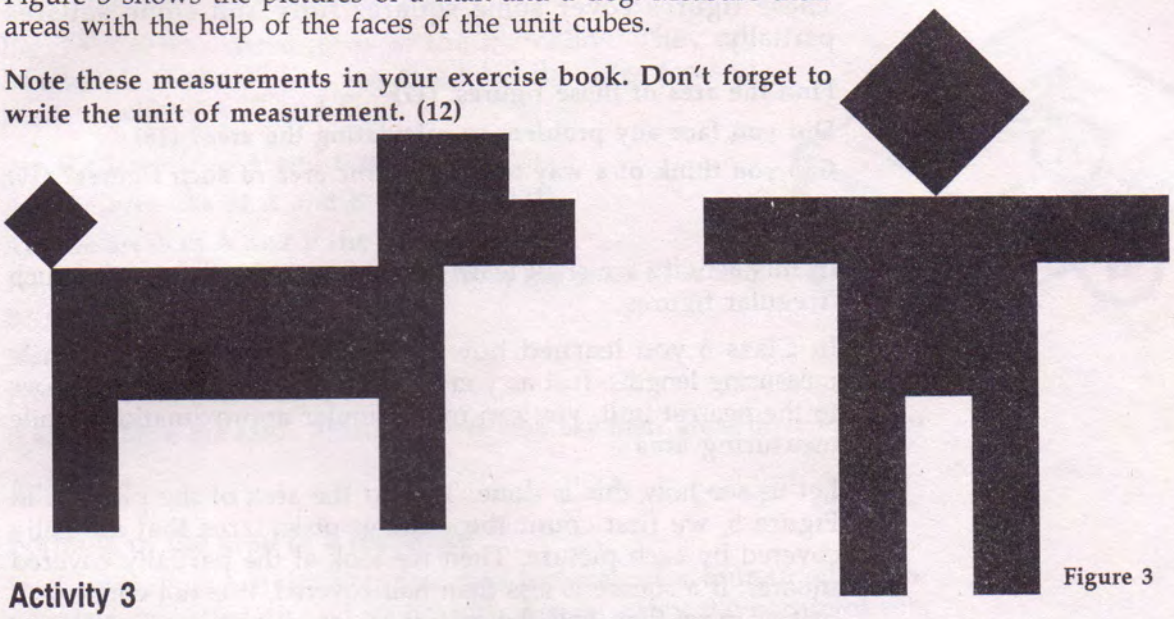


Figure 3

Activity 3

Measuring area with a sheet of graph paper:

We can also measure area with a sheet of centimetre graph paper. One such sheet is shown in Figure 4. It consists of horizontal and vertical lines one centimetre apart.

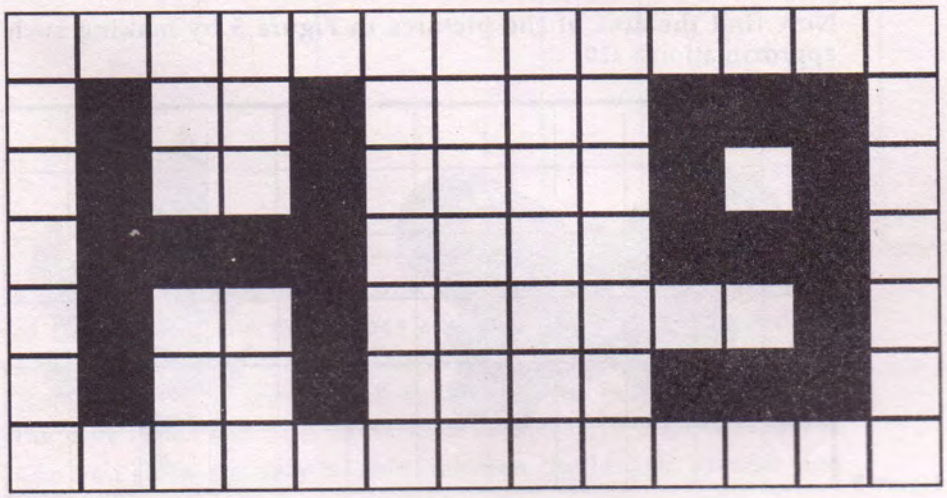


Figure 4

What is the length of one side of each square in this sheet? (13)

How many plastic cubes can you place on a square? (14)

What is the area of one square? (15)

The number of squares a figure or shape covers on the centimetre graph paper is equal to the area of the figure in square centimetres.

Two figures are drawn on the graph paper.

Find the area of both these figures. (16)

All the squares contained in the two figures in Figure 4 were complete squares. Now look at the figures drawn in Figure 5. These figures cover some squares fully and some squares partially.

Find the area of these figures. (17)

Did you face any problem in calculating the area? (18)

Can you think of a way to measure the area of such figures? (19)

Activity 4

In this activity we shall learn how to measure the area of such irregular figures.

In Class 6 you learned how to make approximations while measuring lengths. Just as you made approximations of distances to the nearest unit, you can make similar approximations while measuring area.

Let us see how this is done. To find the area of the pictures in Figure 5, we first count the number of squares that are fully covered by each picture. Then we look at the partially covered squares. If a square is less than half covered, it is not counted. If half or more than half the square is covered, it is counted as a full square.

Thus, the area of the picture is the number of squares fully covered by the figure + the number of squares that are either half or more than half covered by it.

Now find the area of the pictures in Figure 5 by making such approximations. (20)

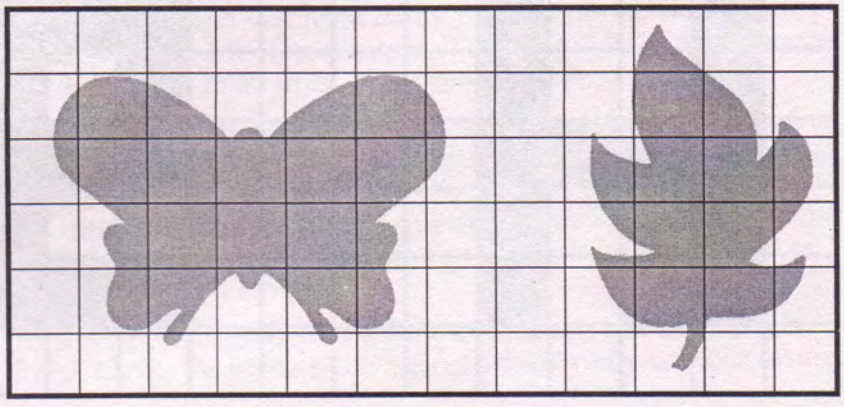


Figure 5

Length, breadth and area

You have seen how you can calculate the area of various figures with the help of a centimetre graph paper.

What are the possible factors on which the area of any figure depends? (21)

We shall try to identify these factors in the following activities, using a simple rectangular figure.

Activity 5

Take a matchbox.

How many faces does it have? (22)

Figure 6 shows three faces of the matchbox. They are labelled A, B and C. You can also label the three faces of your matchbox A, B and C.

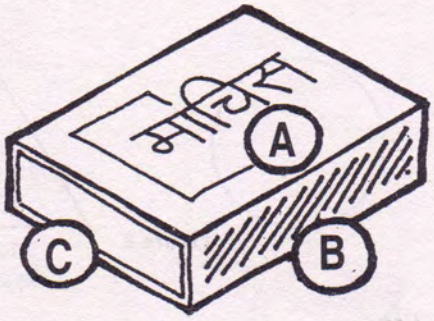


Figure 6

Are the lengths of A and B the same? (23)

Are the breadths of A and B the same? (24)

Are the areas of A and B the same? (25)

What is the reason for the difference in the areas of A and B? (26)

Now look at B and C.

Which face has the larger area? (27)

B and C have the same breadth. Then why are their areas different? (28)

Activity 6

Formula of the area of a rectangle

In the previous activity you saw that the area of a four-sided figure depends on its length and its breadth. Let us study the nature of this relationship.

Three rectangles A, B and C are shown in Figure 7.

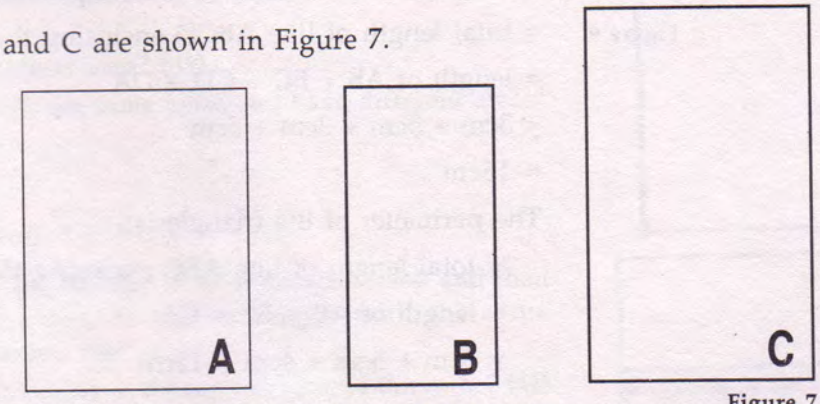


Figure 7

Measure the length and breadth of each rectangle with the help of the sides of the unit cubes and note your measurements in Table 1. (29)

Now measure the area of A, B and C with the help of the faces of the unit cubes and note these measurements in the table. (30)

Can you show the relationship between the length, breadth and

area of the rectangles in the table in the form of a formula? (31) Do you think this formula can be used to calculate the area of any figure? (32)

Table 1

Rectangle	Length	Breadth	Length x Breadth	Area (with the help of the faces of the unit cube)
A	..... cm	..... cm	..... cm^2	..... cm^2
B				
C				

If you use the formula to calculate the area of a figure, how would you check if your answer is correct. (33)

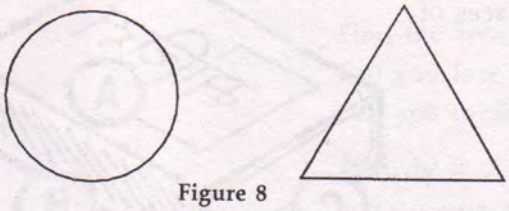


Figure 8

Look at the two shapes given in Figure 8.

Can the area of these two figures be calculated using the formula we used for rectangles? (34)

The formula Length x Breadth = Area can be used only for rectangular shapes. You will need other formulae for figures of other shapes like triangles or circles. Remember that each distinct shape will have a different formula and that there is no formula for irregular figures.

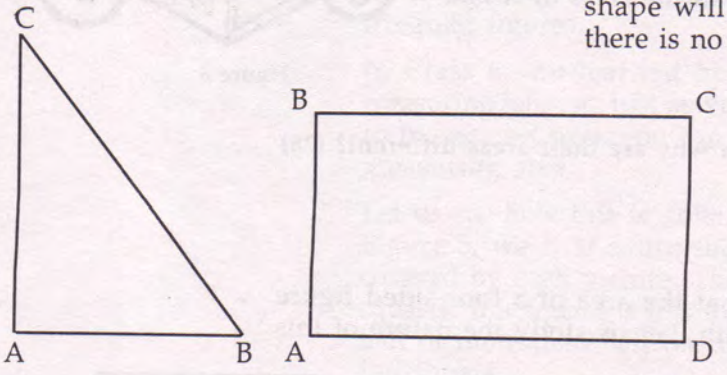


Figure 9

The perimeter : Enclosing a shape

The length of the line that encloses a shape is called its **perimeter**. The perimeters of two shapes are calculated here as an example (Figure 9).

The perimeter of the rectangle is

= total length of line ABCD enclosing the rectangle

= length of AB + BC + CD + DA

= 3cm + 5cm + 3cm + 5cm

= 16cm

The perimeter of the triangle is

= total length of line ABC enclosing the triangle

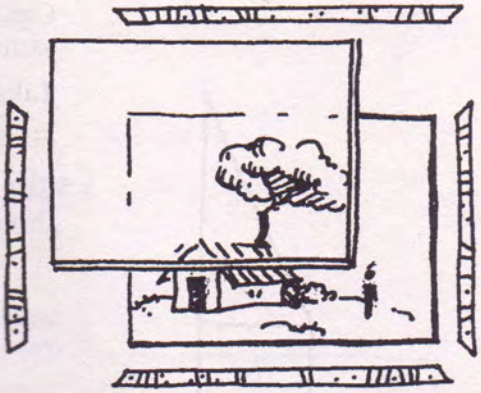
= length of AB + BC + CA

= 3cm + 5cm + 4cm = 12cm

Measure the perimeter of a page of your *Bal Vaigyanik* workbook and a page of your exercise book. (35)

Both the perimeter and the area depend on the size of the figure. But this does not mean that the perimeter and area are different names for the same thing. They are entirely different concepts.

The perimeter is the length of the line enclosing a figure while the area is the surface spread of the figure, or how much space that surface occupies or covers. The perimeter is measured in cm while area is measured in cm^2.



If, for example, a photograph is to be framed, the length of wood for the frame will depend on the perimeter of the photograph. On the other hand, the size of the glass to cover the photograph will depend on its area. Similarly, to estimate how much wood we need to make the frame of a door, we must measure the perimeter of the door. However, to assess how much paint is needed to paint the door, we must measure its area.

In the following two activities we shall study the difference between perimeter and area in more detail.

Activity 7

Same perimeter, different areas

One can draw different shapes having the same perimeter. Would the area of these shapes be the same? Let us find out.

Take a thin wire or thick thread that is a little over 16 cm long. Join its two ends and spread the wire/thread on a sheet of graph paper. Make the following shapes one by one:

a) A square whose side measures 4 cm.

b) A rectangle with a length of 5 cm.

c) A rectangle with a length of 7 cm.

d) A circle.

What are the perimeters of each of these shapes? (36)

Measure the area enclosed by the wire/thread in each case. You can do this by counting the number of squares it covers on the graph paper. (37)

Which shape has the largest area? (38)

Can different figures with the same perimeter have different areas? (39)

An exercise

Figure 10 is a diagram of a triangle.

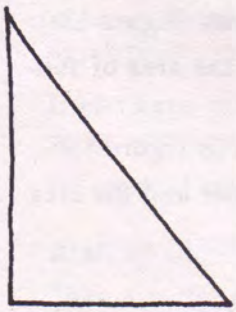


Figure 10

Copy the triangle in your exercise book and then draw a square and rectangle with the same perimeter. (40)

Are the areas of these three shapes the same? (41)

Activity 8

Same area, different perimeters

You made shapes with the same perimeter but different areas.

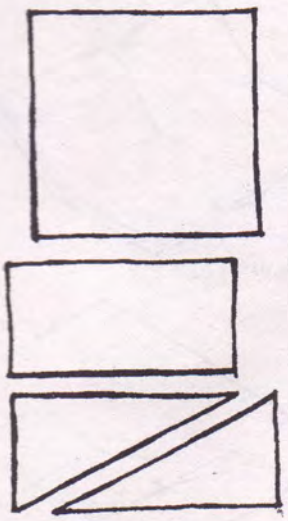


Figure 11

Can you do the reverse? That is, can you make shapes with the same area but different perimeters? Let's try.

Take a rectangular piece of paper.

Find its perimeter and area. (42)

Cut it into three pieces as shown in Figure 11. Now join the three pieces together in different ways as shown in Figure 12.

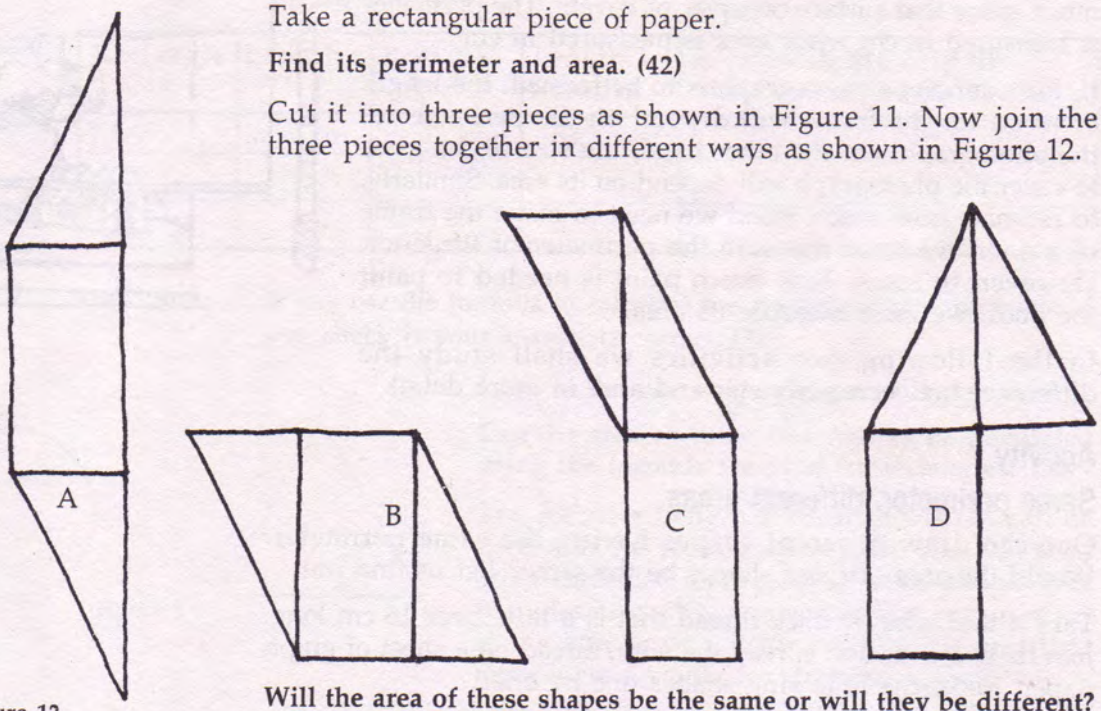


Figure 12

Will the area of these shapes be the same or will they be different? Give reasons for your answer. (43)

Measure the perimeters of these shapes. (44)

Can different figures with the same area have different perimeters? (45)

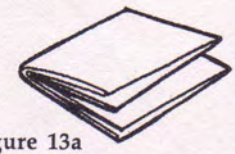


Figure 13a

In this activity you joined pieces of paper in different ways and made a variety of shapes. In the same way, a tailor cuts cloth in different ways and makes a variety of clothes. This is both a skill and an art.

Activity 9

Perimeter and area - How do they increase?

The activities you have done so far show that the perimeter and area depend on the length of the sides of a figure. However, do the area and perimeter change in the same ratio if a figure is made smaller or bigger?

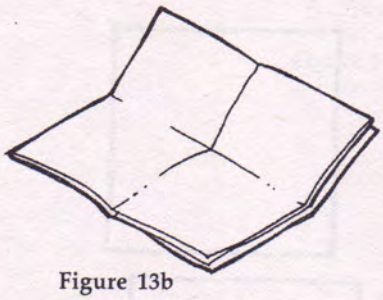


Figure 13b

Take a square piece of paper and fold it four times (Figure 13a).

Find the length of the side, the perimeter and the area of this folded paper and note these in Table 3. (46)

Unfold two folds of the paper, as shown in Figure 13b.

Note the length of the side, the perimeter and the area of this unfolded paper in the table. (47)

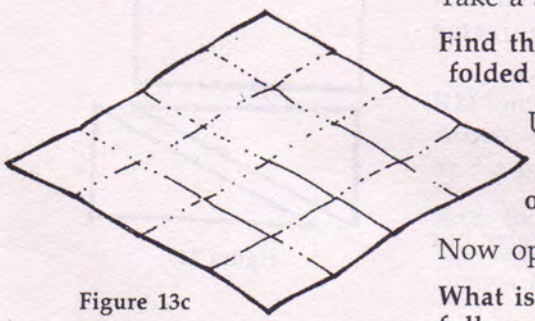


Figure 13c

Now open the paper fully (Figure 13c).

What is the length of the side, the perimeter and the area of the fully opened paper? Note these in the table. (48)

Length of side (cm)	Perimeter (cm)	Area (cm^2)
Paper folded four times		
Paper folded twice		
Paper opened fully		

Table 3

Answer the following questions on the basis of your entries in Table 3:

When the length of the side of a square doubles, its perimeter and area also increase, but in different ratios. What are these ratios? (49)

When the length of the side increases four times, how many times do the perimeter and area increase? (50)

When the length of each side is halved, how much smaller does the area become? (51)

This relationship between the length of the sides, perimeter and area is also seen in other shapes

Let us test whether this relationship holds good for a triangle. Cut a sheet of paper in the shape of an equilateral triangle. Make a table similar to the one above. Now fold the paper in the way shown in the Figure 14 and record your observations in the table.

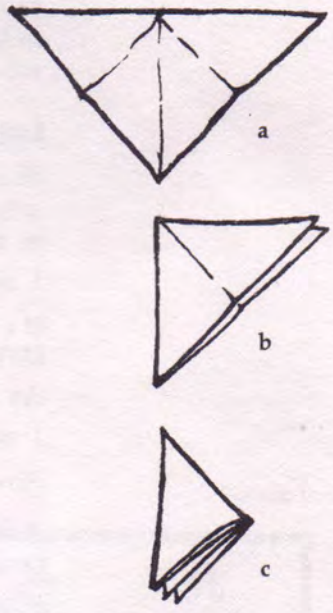


Figure 14

What conclusions can you draw on the basis of this table? Write them in your own words. (52)

There is one point you should always remember. The relationship between the length of the sides, perimeter and area holds good only if the shape of the figure does not change while reducing or enlarging it. In the two activities you did with a square and an equilateral triangle their shapes did not change. That is, they remained a square or an equilateral triangle. But if the square turns into a rectangle while folding it in half, this relationship does not hold good.

Units of area

You have used sq cm to measure area until now. There are other units to measure area.

When measuring lengths you used units like centimetre, metre and kilometre. You saw that it is better to measure small lengths in centimetres. However, for longer lengths (for example, the distance between two villages or towns) kilometres are more appropriate units.

If you have to measure the area of a field or a farm, would sq cm be an appropriate unit? (53)

Let us find out more about larger units for measuring area.

Activity 10

Take a metre scale and draw a square with a side equal to one metre on the floor. The area of this square is 1 square metre.

Square metre is also written as metre^2, m^2 or sq m. A sq m is also a unit of area.

How many 1 cm cubes can you place along one side of a square measuring 1 sq m? (54)

How many 1 cm cubes can you place along the other side of the same square? (55)

On the basis of the last two questions can you calculate how many square centimetres equal a square metre? (56)

A square metre is an appropriate unit to measure the floor area of a room or a *kabbadi* field. For example the international size of a *kabbadi* field is 125 sq m. However, to measure larger spaces like a field, you would require a unit even larger than a square metre.

Units to measure a field

The area of a field is commonly known as its ***rakba***. The *patwari* uses a unit called a **decimal** to indicate the measurements of agricultural fields in the land survey records (***khasra-khatauni***) of his village.

1 decimal = 40 sq m

If a farmer has 2.5 decimals of land, what is the area of his field in sq m? (57)

An acre is a larger unit than a decimal.

1 acre = 100 decimal

How many sq m will there be in an acre? (58)

A hectare is also a unit often used to measure the area of fields and farms.

1 hectare = 10,000 sq m

Questions for revision

1. **Find the surface area of your pencil by wrapping paper around it.**
2. **Land in a village is being sold at the rate of Rs 10 per sq m. Calculate the cost of 3 acres and 5 decimals of land.**
3. **Draw a rectangle with a length of 7 cm and an area equal to that of the rectangle in Figure 15. Are the perimeters of these two figures the same?**
4. **Can there be a figure which has no area? Discuss this in class and summarise your discussion in your own words.**
5. **Gopal built a room. It cost him Rs 1,000 to tile the floor. Kamal built a room with a length and breadth double that of Gopal's room. How much will Kamal have to spend on flooring his room?**
6. **Find out the area of the following, using a sheet of graph paper. You will need to draw their outlines on the graph paper.**

   A bangle;
   Your palm;
   The scale in your compass box;
   Various leaves, such as *besharam*, mango, guava, etc.

   Can you find the area of a tamarind leaf using the same method? What problems would you face?

Figure 15

New words

Perimeter *Rakba* Decimal *Khasra-khatauni*